THE TRANSPORTATION TOMORROW SURVEY

1991

DESIGN AND CONDUCT OF THE 1991 SURVEY

FIRST REPORT OF 1991 SERIES

Ontario

A survey conducted by:
The Data Management Group, University of Toronto for:
the Regions of Durham, Halton, Hamilton-Wentworth,
Peel and York; Metropolitan Toronto, Ministry of Transportation,
GO Transit and the Toronto Transit Commission.

1991 TRANSPORTATION TOMORROW SURVEY

A Telephone Interview Survey on
Household Travel Behaviour in the
Greater Toronto Area Conducted in the
Fall of 1991

Design and Conduct of the Survey
Final Report

Prepared for the
Toronto Area Transportation Planning
Data Collection Steering Committee

by the

Data Management Group
University of Toronto
Joint Program in Transportation
October 1992

Participating Agencies:

Ministry of Transportation, Ontario
Regional Municipalities of:
Metropolitan Toronto, Durham, York
Peel, Halton, Hamilton-Wentworth
GO Transit
Toronto Transit Commission

This report was prepared for the Toronto Area Transportation Planning Data Collection Steering Committee by the Data Management Group at the University of Toronto. The principal authors are Peter Dalton and Jerry Ng. The report was assembled and edited by Katrien Mabalay. The authors would like to express their appreciation to the members of the Survey Technical Committee for their review and comments. The views and opinions contained in the report are of the authors and do not necessarily reflect those of the participating agencies or the Data Management Group.

Acknowledgements

Nine agencies were represented on the Technical Working Committee which planned and conducted the 1991 survey. Individuals on the main committee also contributed their time and technical expertise through the various working groups.

The people who served on the main technical committee were:

Murray McLeod, Chairman	Ministry of Transportation
Bill Rhamey, Secretary	Ministry of Transportation
Doug Smith	Ministry of Transportation
James Wong	Ministry of Transportation
Bill Denning	GO Transit
Martin Seekings	Municipality of Metropolitan Toronto
Bill Dawson	Toronto Transit Commission
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Keith Barker	Regional Municipality of Halton
Andrew Head	Regional Municipality of Hamilton-Wentworth

The chairmen of the working groups were:

Dr. Ali Mekky	Sample Design
Bill Dawson	Survey Design
Jim Bate	Coding
Bill Rhamey	Quality Control
John Barnes	Publicity
Martin Seekings	Validation
John Barnes	Finance

Pentti Suokas, of the Ministry of Transportation was a member of the Sample Design group.

Mike Wehkind, of Metropolitan Toronto, and Wayne Nichols, of the Toronto Transit Commission were members of the Coding group.

John Cooper and Rita Cicero, both of the Ministry of Transportation, were members of the Publicity Team along with John Scott of the Regional Municipality of York.

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Jill Dalton was responsible for administering the survey payroll during the conduct of the survey.

The BA Group undertook the development of both the Direct Data Entry and Sample Control Software. Paul Sarjeant produced the Direct Data Entry software and Stuart Bond, the Sample Control Software.

The Direct Data Entry software was tested and evaluated in two pretests by staff of the Environics Research Group under the direction of Jim Matsui and Chris Windsor. The software was also evaluated by Dave Crowley and Toivo Rukholm of Tranplan Associates.

Terry Parr, of the Ministry of Transportation, and Teresa Falcioni, of the University of Toronto, made the necessary arrangements for the installation of phones and phone lines.

The visual monitoring equipment used for remote monitoring of interviews was purchased from Robotel of Cambridge, Ontario. The telephone headsets used by the interviewers were rented from C.G. Industries of Markham, Ontario.

The video clips distributed with the press release were produced by Ted Reagan Productions of Toronto.

The 1991 Transportation Tomorrow Survey relied on a continuation of the team work and cooperation which made the 1986 survey a success. Toivo Rukholm, of Tranplan Associates, was the General Manager of the 1986 survey. His findings and recommendations, as contained in the "Design and Conduct of the Survey", report were instrumental in the design of the 1991 survey.

Finally, the people who were absolutely key to the smooth conduct of the survey included: R. Ian C. Fisher, who was the Chief Supervisor, assisted by Katrien Mabalay and Jerry Ng, who was both the Assistant Manager and the Coding Supervisor, as well as the developer of the coding software.

Peter Dalton
Data Management Group
Survey General Manager

Executive Summary

1. Introduction and Background

The 1991 Transportation Tomorrow Survey was an update of a major travel survey conducted in the fall of 1986. The 1991 survey was conducted from September to December and consisted of telephone interviews with over 22,000 households in the Regional municipalities of Durham, Hamilton-Wentworth, Halton, Metropolitan Toronto, Peel and York. An additional 2200 interviews were conducted in the local municipalities immediately adjacent to the outer boundary of the above area.

The survey was undertaken and jointly funded by the Ministry of Transportation of Ontario, the six regional municipalities in the survey area and the Toronto Transit Commission. Representatives of these agencies met regularly as the Toronto Area Transportation Planning Data Collection Steering Committee (TATPDCSC) which was formed in 1977 to coordinate data collection activities between the agencies.

The 1986 survey was the first comprehensive area-wide survey conducted in the Greater Toronto Area since 1964. The participating agencies have made extensive use of the 1986 TTS data. More than $7 billion has been committed to future transportation projects, the need for which was indicated by the survey. The 1991 survey will provide additional information to help plan those projects, particularly in areas which have experienced rapid change since 1986. Both the 1986 and 1991 surveys were timed to coincide with the Canada Census.

2. Planning and Design

Planning for the 1991 survey started in the fall of 1989. An organizational structure was put in place that reflected the cooperative nature of the project. The Data Management Group at the University of Toronto was requested to prepare a proposal and subsequently appointed a project manager who reported directly to a Technical Sub-Committee of the TATPDCSC. A number of working groups were formed, each chaired by a member of the Technical Committee. The working groups covered the following seven areas of responsibility:

1) Survey Design
2) Sample Design
3) Quality Control
4) Publicity
5) Coding
6) Validation
7) Finance

The 1986 survey obtained completed interviews for 61,000 households, a 4.1% sample of all households in the survey area. Due to financial constraints, the 1991 survey was planned as a smaller update of the previous one. The Technical Committee decided that in areas which had experienced significant growth (greater than a 17% increase in population), the sampling rate would be approximately the same as in 1986, whereas in other areas, it would be reduced to 0.5%. The Committee also decided to expand the 1986 survey area to include a band of

local municipalities adjacent to the Greater Toronto Area (GTA). This area was incorporated to provide better information on travel movements across the boundary and immediately inside the previous survey area.

The most significant change made to the conduct of the survey was the adoption of the Direct Data Entry software. In 1986, interviewers recorded responses to the survey using paper and pencil. The information was subsequently keyed into computers by a separate group of people. For the 1991 survey, interviewers were required to enter all information directly into computers as the survey was being conducted. The primary objectives in adopting the direct data entry approach were improved quality control and a reduction in the time required to process the information once the survey was complete. The BA Group was contracted to develop the software for both the direct data entry and sample control.

3. Interviews

Interviews were conducted by telephone between September 5 and December 15, 1991. Interviewing hours were 6 to 10 pm on weekdays and 12 noon to 5 pm on Saturday. The trip data collected was always for the previous weekday except for some Thursday data collected on Saturdays to avoid over-representation of Friday trips. Telephone interview facilities were set up in a room belonging to the Department of Civil Engineering at the University of Toronto. A Chief Supervisor was appointed who recruited and trained the interview staff specifically for this survey. The facilities included phones and computers for a maximum of 33 interviewers to be working at one time. A total of 75 interviewers and supervisors were hired to provide adequate staffing for the duration of the survey.

The sample of households (names, addresses and telephone numbers) was supplied by Teledirect, a subsidiary of Bell Canada, and was an extraction of residential phone listings from the white pages sorted by postal code and street address. Up to eight attempts were made to contact each household.

During the first few weeks of the survey, major disruptions were caused by a Canada Post strike immediately followed by a public transit strike in Metropolitan Toronto. The training of interviewers was temporarily suspended and no interviews were conducted for households within Toronto and the immediately adjacent areas during the transit strike or on the following ten days. The strikes are not expected to affect the quality of the final data.

4. Coding

The coding process involved an initial series of electronic consistency checks and a visual review of each interview print out by a supervisor. Where necessary, inconsistent interviews were returned to the original interviewer to call back the household for clarification or correction. Due to the logic checks built into the direct data entry software, very few call backs were necessary.

Interview Statistics

Number of Interview Stations (Computers & Telephones)	33	
Number of Staff Recruited (Interviewers & Supervisors)	75	
Average Completion rate (Interviews per paid hour)	3.76	
Sample Used (Attempted to Contact)	34,167	
Eligible Contacts	27,813	(81.4%)
Refusals	3,160	(11.4%)
Completed Interviews	24,653	
Invalid or Not Usable	146	
Households in Final Database	24,507	
Overall Completion Rate	72%	

	Number of Completed Interviews	Percent of all Households
Metropolitan Toronto	7363	0.9%
Durham	2951	1.8%
York	4384	2.7%
Peel	3964	1.7%
Halton	1509	1.4%
Hamilton-Wentworth	2116	1.4%
Fringe Area	2224	4.1%
TOTAL	**24507**	**1.4%**

After the review process, all geographic data that were collected, such as addresses and place names, were assigned X and Y coordinates based on the Universal Transverse Mercator (UTM) 6 degree system. This "geocoding" process was first used in the 1986 survey and has since become standard practice for all travel surveys conducted in the Toronto area. The geocoding process is highly automated and makes extensive use of Area Master Files supplied by Statistics Canada. An Area Master File is a street map stored in electronic format including the coordinates for each blockface and intersection together with the appropriate address range.

One of the goals of the Coding Team was for the coding process to keep pace with the conduct of the interviews. In that way, any problems could be corrected immediately and call backs could be made while the interview was still fresh in the minds of the respondents. This objective was achieved by a team of six coders and one supervisor. With few exceptions, all information was coded within three working days of the interview being conducted and the coding operation was fully complete by the end of January 1992. In 1986, it required more than six months after the completion of the survey to fully code all of the interviews.

5. Survey Costs

The budget established for the survey, including development, report production and analysis, was $877,000 based on a minimum target of 23,000 completed interviews. The final cost is expected to be $834,000 ($43,000 under budget) for 24,500 completed interviews with the following breakdown:

Development	$173,000
Conduct of the Survey	$481,000
Analysis & Reports (Estimated)	$180,000
Total	$834,000

The following table gives a breakdown of the costs associated with the actual conduct of the survey compared with costs from the 1986 survey. An inflation factor of 27% has been used to adjust the 1986 costs to 1991 values.

The unit cost of interviewing was 30% higher than in 1986 primarily due to significantly higher wage rates paid to recruit and retain good interviewers. The higher interviewing costs were more than offset by a reduction of 70% in unit coding cost. The reduction in coding costs can be attributed to better quality control in the conduct of the interviews and to improvements in the geocoding software procedures. The total cost per household was unchanged at $19.63. Development costs were significantly higher for the 1991 survey at $173,000 versus $48,000 for the 1986 survey. These cost comparisons do not take into account the fact that significantly less demands were made on the supporting agencies for their staff time and ancillary support services in both the preparation and conduct of the 1991 survey compared to the 1986 TTS.

Variable Costs (1991 $)
(Proportional to number of interviews)

	1991	($/Household)	1986	($/Household)
Interviewing	$208,000	(8.49)	$ 403,000	(6.54)
Coding	$ 50,000	(2.03)	$ 423,000	(6.85)
Miscellaneous	$ 53,000	(2.18)	$ 144,000	(2.33)
Sub-Total	$311,000	(12.69)	$ 970,000	(15.72)

Fixed costs (1991 $)
(Not directly related to number of interviews)

	1991	($/Household)	1986	($/Household)
Pilot Survey	$ 5,000		$ 47,000	
Management	$ 92,000		$112,000	
Other	$ 73,000		$ 83,000	
Sub-Total	$170,000	(6.94)	$242,000	(3.91)
Total	**$481,000**	**(19.63)**	**$1,212,000**	**(19.63)**

6. Conclusions and Recommendations

All of the targets set for the conduct of the survey were achieved and at less cost than was originally budgeted. Early indications are that the quality of the data is at least as good, and probably better than the 1986 survey, which has proved to be very reliable for many different applications. The following conclusions and recommendations are preliminary in nature pending detailed analysis of the survey data:

6.1 Organization

The organizational structure that was put in place for the 1991 survey was effective in minimising the demands made on the staff of each agency. The management structure provided continuity throughout the survey process and ensured the results were obtained in a timely manner. It is strongly recommended that one individual have the project management responsibility for any similar survey from the initial planning stages through to the analysis of the final database.

6.2 Direct Data Entry

The Direct Data Entry software was cost effective and successful in maintaining high standards of quality control and in speeding up the post survey processing while enabling higher than expected productivity rates to be achieved. Its use in future surveys is recommended with the following **essential** provisos:

a) Other parts of the process including sample selection, performance monitoring and coding be automated as part of a totally integrated process.

b) Adequate lead time must be available for development and testing. 12 to 18 months is suggested as a minimum for a new application and 6 to 12 months for a repeat survey using the same process with near identical content.

c) Support staff, with the appropriate computer skills, are available for trouble shooting at all times during the conduct of the survey.

6.3 Transit Route Information

The Direct Data Entry software was particularly effective in the collection of detailed information on the use of specific transit routes. On-line checks incorporated into the software eliminated at least 95% of the post survey checking and processing requirements and ensured a much higher degree of accuracy and completeness than was achieved in 1986. To fully realise the benefits of this improved data quality, it will be necessary to conduct a full sample (5% plus) in all areas with significant transit service.

6.4 Interviewer Selection, Training and Rates of Pay

In contrast to 1986, there were few problems in recruiting mature responsible interviewers and in retaining them for the duration of the survey. The superior quality of the interviewers was a significant factor in the speed of post survey processing and is expected to yield continuing benefits in the quality of the data which was collected. The key factors in this success included:

a) the smaller number of interviewers required

b) a downtown location

c) the ability to retain staff from the pilot survey as supervisors

d) extensive one on one training

e) premium rates of pay and incentive bonuses, and

f) a positive work environment.

6.5 Geocoding

Automated geocoding is a proven technology enabling geographic data to be assigned to precise coordinates at a fraction of the cost of manual assignment to a pre-determined zone system. The new software developed for this survey was particularly effective and it is recommended that the Committee consider its adaptation to other geocoding requirements. The availability of the Area Master File from Statistics

Canada has been instrumental in the development of geocoding systems. The geocoding systems could be made even more effective if the AMF can be maintained on a timely and consistent basis in all areas, including those which are predominantly industrial or commercial. It is recommended that the Committee give consideration to an ongoing cooperative program of maintaining AMF type files specific to the needs of transportation planning.

6.6 Survey Content

The most significant change in the survey content from the 1986 survey was the inclusion of place of work and place of school questions as part of the person information. The changes improved the flow of the interview and should provide additional valuable information on employment. It is recommended that these questions be retained in future surveys and that consideration be given to using the data as an alternative source of basic employment data to the Canada Census if speedier and more cost effective methods of processing the census data are not found.

Problems were experienced in recording the language in which the interviews were conducted. The information collected is believed to be meaningless for studying travel behaviour as it relates to ethnic background. Inclusion of a question such as, "What language is spoken most often at home?", would be more effective for that purpose.

6.7 1996 Survey

It is apparent from the validation of the 1991 data that significant changes in travel behaviour have taken place since 1986 even in the low growth areas. These changes highlight the need to collect travel behaviour data on a regular and consistent basis. For 1996, it is recommended that a full 5% sample of households be surveyed in all regions and that consideration be given to expanding the survey area to include the Regional Municipality of Niagara. A survey of this magnitude, 90,000 - 100,000 households, will require extensive pre-planning and early commitments from the participating agencies. As a first step, it is recommended that the Steering Committee establish what organizational structure they want to manage the survey and review the alternative strategies for the actual conduct that are suggested in Chapter 11 of this report.

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* Note: Appendices III, IV and V are printed as separate reports

1.0 Introduction

In the fall of 1986, a comprehensive travel survey (the Transportation Tomorrow Survey) of the Greater Toronto Area (GTA) was conducted. This was the first area-wide survey of its kind since the Metro Toronto Area and Region Transportation Study (MTARTS) of 1964. The 1986 Transportation Tomorrow Survey (TTS) was a joint undertaking by the agencies represented on the Toronto Area Transportation Planning Data Collection Steering Committee (TATPDCSC). In 1977, the Committee was established for the purposes of setting common transportation data standards and for coordinating data collection and dissemination between all the agencies. Membership of the Committee includes, the Regional Municipalities of Metropolitan Toronto, Durham, York, Peel, Halton and Hamilton-Wentworth, the Toronto Transit Commission, GO Transit and the Ontario Ministry of Transportation (MTO). After completion of the 1986 survey, the Data Management Group was formed at the University of Toronto with one of its prime objectives being the management and distribution of the 1986 TTS data.

The 1986 survey design relied extensively on earlier surveys conducted in Montreal by the Montreal Urban Community Transit Commission. These surveys had been carried out every four years since 1968 providing a valuable source of transportation time series information. Members of TATPDCSC hoped the 1986 survey would be the first in a similar ongoing data collection program. Discussions about the need and timing of the next survey started in 1988. A general consensus was reached that future surveys should coincide with the five year cycle of the Canada census, but there was disagreement on whether the next survey should be in 1991 or 1996. Arguments in favour of 1991 included the need to update information for those areas experiencing high growth rates, the demand to create a transportation time series database, particularly for public transit service planning, and the desire to build on the experience gained in conducting the 1986 survey.

A decision was reached when the Committee approved of an undertaking to update the 1986 survey in 1991. Areas which had experienced high growth would be sampled at approximately the same rate as in 1986, whereas, areas without a significant change in population would be sampled at a much lower rate. The fall period, September to December, was selected for the conduct of the survey both for consistency with 1986 and because it provides the longest period of relatively stable travel patterns not affected by vacations or adverse weather conditions. The Data Management Group was requested to prepare a proposal for the management of the survey. In 1986, the Steering Committee hired a General Manager for the survey and the Metropolitan Toronto Planning Department acted as the prime contractor and financial manager for the sub-contracting of services and subsequent invoicing to the other agencies. The Data Management Group managed all aspects of the 1991 survey including sub-contracting and financial management. Exhibit 1.0 is a summary of key events leading to the preparation and completion of the 1991 TTS.

The report on the design and conduct of the 1986 survey contained a number of recommendations for the conduct of future surveys which were used as a starting point for the design of the 1991 survey. Recommendations included strong endorsements of the telephone survey methodology as a cost effective method of collecting household travel information and of the automated geocoding process used to assign UTM coordinates to all geographic information collected. The most significant change recommended was the use of Direct Data Entry (DDE) software where interviewers would key the survey data directly into computers while conducting interviews. The potential advantages envisioned with the use of the DDE software included better quality control over the collected data and a more effective progress and performance monitoring of the interviewers. A substantial reduction in elapsed time required to code, check and validate the collected data was

viewed as the greatest benefit of implementing the software. The prototype DDE software was tested as part of a pilot study for the 1986 survey with promising results. However, the software was rejected for the main survey because of the risks involved in applying it to such a large survey within the available time frame. The development and application of the DDE software were fundamental components in the Data Management Group proposal for the 1991 survey.

Exhibit 1.0
Schedule of Key Events

1977	- Formation of the Toronto Area Transportation Planning Data Collection Steering Committee (TATPDCSC)
September 1986 - December 1986	- Conduct of 1986 Transportation Tomorrow Survey (61,708 households interviewed)
August 1988	- Version 2.0 of the 1986 TTS database released - Data Validation Report published
August 1988	- Data Management Group formed at the University of Toronto
April 1989	- Version 3.0 of the 1986 TTS database released
June 1989	- Travel Survey Summary for the Greater Toronto Area published
September 1989	- TATPDCSC requests the Data Management Group prepare a proposal for the conduct of a 1991 survey
December 1989	- Data Management Group appointed to manage the 1991 survey
January 26, 1990	- First meeting of Survey Technical Committee
May 1990	- BA Consulting retained to develop the Direct Data Entry software
December 1990	- First pretest of the Direct Data Entry software (22 Interviews)
January 1991	- Chief Supervisor appointed
February 1991	- Second pretest of the Direct Data Entry software (93 Interviews) - Decision to conduct the main survey from the University of Toronto premises
June 1991	- National census (Statistics Canada) - Third pretest of software
July 1991	- Pilot survey (817 Interviews)
August 1991	- Training of supervisors and recruitment of interviewers

Exhibit 1.0 (continued)
Schedule of Key Events

August 26, 1991 - September 5, 1991	- Canada Post strike
September 5, 1991	- Start of interviewing
September 10, 1991	- Start of coding operation
September 12, 1991- September 19, 1991	- Toronto Transit Commission public transit strike
December 13, 1991	- Completion of interviewing operation (24,653 households interviewed)
January 23, 1992	- Final call back to verify collected information and to complete the survey
January 30, 1992	- Completion of coding operation
March 3, 1992	- Version 1.0 of the 1991 TTS database released

2.0 Planning and Organization

Two problem areas experienced in the 1986 survey were the lack of continuity in the management of the survey and the difficulty of recruiting a sufficient number of interviewers (120) with the appropriate aptitude. The continuity problem arose because the project manager was hired for only nine months to oversee the selection of the contractor and the actual conduct of the survey. All preparation work, geocoding and analysis were managed, for the most part, by the Ministry of Transportation and staff from the various agencies. The Data Management Group proposal addressed this problem by putting a management structure and staffing plan in place for a three year period. The interviewer staffing problem was addressed by recognizing the need to set wage rates above the norm for market research interviewers and by locating the survey office in a centralized location with convenient subway accesses.

2.1.0 Committee Structure

Exhibit 2.1.0 is an organization chart showing the reporting relationships adopted for the survey. A technical sub-committee (Survey Technical Committee) of TATPDCSC was formed with one member from each of the agencies participating in the survey. The Data Management Group appointed a Survey General Manager, Peter Dalton, who reported directly to the Survey Technical Committee. Major elements of the survey were assigned to a series of working teams, each one chaired by a member of the Survey Technical Committee. The Survey General Manager was a member of all the working teams and was responsible for the coordination between each team. Team meetings were held whenever needed. The chairmen reported to the Survey Technical Committee which met once every 4 to 8 weeks starting in January 1990.

Survey Design Team

The Survey Design Team was responsible for the content and design of the survey questionnaire, the interview script, the specifications for the development of the DDE software and the selection of the Chief Supervisor. The team was also in charge of all policies and procedures relating to the conduct of the interviews and the selection and training of interviewers.

Sample Design Team

The Sample Design Team was responsible for defining the survey area and the high growth areas. They also determined the sampling rates and sampling procedures, as well as the method of expansion and integration with the 1986 data.

Coding Team

The Coding Team reviewed the source material, such as the Area Master File (AMF) and monument files available for use in the geocoding procedures. They were responsible for defining the coding software requirements and the procedures for selection, training and monitoring of the coding staff, including the selection of the Coding Supervisor.

Quality Control Team

The Quality Control Team was responsible for the documentation of procedures and the review of all survey material for consistency and completeness. The team was also responsible for ensuring that monitoring and control procedures were adhered to.

Publicity Team

The Publicity Team was responsible for the content and printing of the advance letter sent to participating households. The team designed the publicity and public relations program which involved radio, newspaper and television media coverage, politicians, municipal police and local government officials.

Validation Team

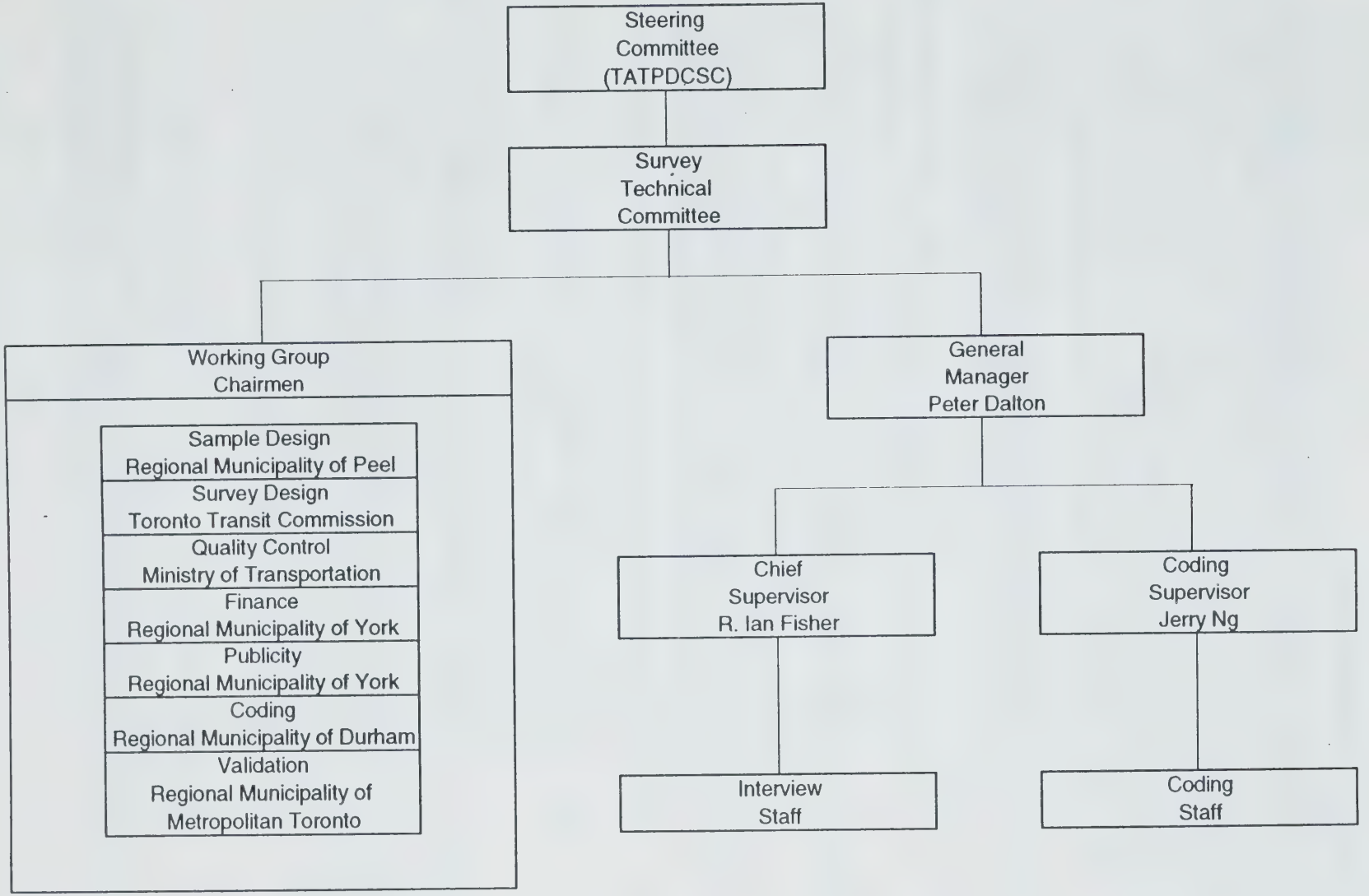
The Validation Team was responsible for defining suitable procedures and geographic areas for expansion of the survey data. They also assembled data needed to represent the total population of the survey area including, integration with the 1986 data where appropriate. The team made comparisons with data from other sources, such as the 1986 survey, the national Census, employment surveys, cordon counts and transit ridership counts to determine any biases created in the data and to make recommendations for correcting these problems.

Finance Team

The Finance Team reviewed budget estimates, made recommendations on cost allocation to the different agencies, defined the billing procedures and monitored expenditures.

The original plan also included a Report Design Team that was never activated.

Exhibit 2.1.0
Organization Chart of the Survey Technical Committee



2.2.0 Survey Design

The original proposal assumed there would be a pilot survey carried out in February 1991. However, the Survey Design Team recommended that development of the DDE software could be carried out more effectively and with less risk by undertaking a series of smaller scale pretests, each one involving additional components to the previous one. The main purpose of the pretests was to test and refine the software and the content of the survey and not to compare or evaluate different methodologies. The main pilot survey was postponed to July 1991, with the objective of providing a large scale final test of all components of the survey. No changes were to be made to the survey content or the DDE software between the pilot and the main survey unless they were essential for the smooth operation of the survey. Advantages in postponing the pilot were that:

a) it allowed more time for the development of reference material for geocoding and the testing of the most up-to-date material available for the survey including the pre-census version of the AMF from Statistics Canada and;

b) it was possible to use the pilot survey to recruit and train survey staff (particularly interview supervisors) for the main survey.

2.2.1 Questionnaire Content

The questionnaire from the 1986 survey was used as the starting point for reviewing the contents for the 1991 survey. Compatibility with the 1986 survey and cost control were key factors which led to a decision that modifications should be strongly resisted. The onus was on proponents to justify changes to any of the questions. The review process involved the following steps:

1. An initial review was made to determine if any questions from the 1986 survey could be dropped.

2. Each agency was asked to supply a list of additions or changes to the 1986 questionnaire they felt were appropriate.

3. These lists were reviewed by both the Survey Design Team and the Survey Technical Committee to determine what changes should be incorporated to the DDE software for the initial pretests.

4. Following the second pretest, proposed additions were reviewed again and those which appeared to be of questionable value were deleted.

Deletions From the 1986 Survey

1. Intersection Quadrant

The only item of information deleted from the 1986 survey was the intersection quadrant (when the name of an intersection was given as a location). This item was deleted to improve the flow of the interview. The only reason for collecting this information in 1986 was to ensure that

the data could be assigned to the correct traffic zone should the intersection be the meeting point of two or more zone boundaries. Having the coordinates of the actual intersections provides flexibility to distribute the trip data between adjacent zones either randomly or in proportion to population or other zonal factors.

Additions to the 1986 Survey

1. Place of Work

All employed persons were asked to give the location of their place of work. In 1986, this information would only have been obtained as part of the trip data if they made a trip to work that day.

2. Name of School

All students over the age of 11 were asked for the name of the school they attended. In 1986, this information would only have been obtained if the student had gone to school that day.

3. Free Parking at Work

All employed persons were asked if they had free parking available at work.

Changes in Definitions

1. Qualifying Age

No trip or school information was collected for persons under the age of 11. In 1986, the minimum age was 6. Table 2.2.1 lists trip totals for individuals 6 to 15 years of age. In 1986, approximately 6.25% of the total trips were made by individuals 6 to 10 years of age, but only 1.26% of total transit trips were made by persons in the same age range. Raising the age cut-off was expected to increase interview speed and alleviate some of the concerns parents might have about releasing information for young children. This change was made after an analysis of the 1986 trips revealed that age 11 was the minimum age at which any significant number of people used transit.

2. Employment and Student Status

Employment status (full time or part time), work at home and student status (full time or part time) were asked and recorded as three separate questions to allow for all combinations. The 1986 survey did not permit all combinations to be recorded.

Table 2.2.1
Trip Totals for Individuals 6-15 Years of Age

Age (years)	Total Transit Trips	% of Transit Trips	Total Trips	% of Total Trips
6	1,567	0.11	105,304	1.20
7	1,845	0.14	110,658	1.26
8	2,164	0.16	109,092	1.25
9	2,763	0.20	106,082	1.21
10	3,313	0.24	116,502	1.33
11	5,633	0.41	111,493	1.27
12	10,252	0.75	119,051	1.36
13	15,731	1.15	114,553	1.31
14	28,755	2.11	117,886	1.35
15	36,093	2.65	124,704	1.42
Total	108,116	7.95	1,135,325	12.96

3. Trip Purposes

For the 1991 survey, interviewers were required to assign one of the following trip purposes to each trip that was recorded:

-Home (i.e., return to home)
-Work
-School
-Daycare (added for 1991)
-Facilitate passenger (other than daycare)
-Linked trip (added for 1991)
-Other

The 1986 survey had included the following as trip purposes separate from the "Other" category:

- Entertainment (social and recreational)
- Shopping
- Personal business

These three purposes were excluded on account of the difficulty and relevance of developing exclusive definitions for each of them. For example, trips made to the same shopping mall could be in any of three trip purpose categories or any combination depending on whether they went to a store, bank, movie cinema or restaurant. Nearly all requests for data from the 1986 survey had asked that these purposes be combined. The daycare purpose was added as a result of a number of requests for information that could not be provided from the 1986 survey. The linked trip was added as a convenience to the interviewer when it became apparent that a destination already recorded was not the final destination, but a transfer or stopping point on a longer trip. The linked trip option was rarely used because of the ease with which the interviewers were able to edit the previously entered data with the Direct Data Software.

4. Bicycle Trips

In 1986, information on bicycle trips was collected only if they were to or from school or work. For the 1991 survey, data was recorded for all bicycle trips.

Additions Tested in the Pretests But Not Included in the Main Survey

1. Cost of Parking

In the pretests, respondents were asked to give or estimate, the actual cost of parking at the work location for anyone who was employed. It was apparent from the pretests that many respondents did not know how much other members of the household (if they were to drive to work) paid or would have to pay for parking. There was a strong desire by several agencies to collect data on actual parking costs. However, because of the resulting disruption to the flow of the interview and the reliability of the data being collected, the question was removed in favour of the simpler availability of free parking question.

2. Auto Occupancy

In the pretests, the total number of auto occupants, including the driver, was asked for all auto driver trips. The question was found to be repetitive and non-conducive to the smooth flow of the interview and was later removed in order to meet targets set for interview productivity.

Suggested Changes Not Tested

The following items were suggested as potential additions to the 1986 questionnaire, but were rejected for the reasons given:

1. Length of Time at Present Address

- No justification presented other than it was in GO Transit surveys

2. Types of Vehicles Used or Available

- Usefulness of data was not evident and categorizations would have been difficult

3. Relationship Between People in Household

- Too difficult to frame an additional question in an effective manner
- Possible sensitivity of respondents to a question of this type

4. Occupation

- Time consuming to ask in a telephone interview because of the need to define categories
- Answers were not likely to be reliable or consistent

5. Detailed Employment Characteristics (hours of work, etc.)

- More appropriate in a special purpose survey than in a general household survey

6. Income

- Controversial and awkward to ask in a telephone interview
- Use of categories is time consuming
- Personal income more meaningful than household, but improper to ask of a third party

7. Ethnic Background

- Hard to frame one question which will provide useful and reliable information

8. Availability of Public Transit

- Too subjective
- More reliable data can be derived from transportation network data

9. School Type

- Not necessary
- Students' age and school name already included

10. Length of Time at Current Work Location

- No justification presented other than it was in GO Transit surveys

11. Travel and/or Arrival Time

- Most people give times to the nearest 15 minutes
- It is believed that more accurate and consistent estimates of travel time can be calculated from the transportation network information maintained at the Data Management Group
- Trip start time is required for consistency with the 1986 survey
- Cumbersome to ask for both the start and finish time

12. Specialized Transit Required (physically challenged individuals)

- Difficult to frame an effective question
- Sample size too small to be useful
- More appropriate for a specialized survey

Exhibit 2.2.1 provides an abbreviated summary of the questions asked.

2.2.2 Selection of Chief Supervisor

A competition was held for the selection of a Chief Supervisor for the survey with members of the Survey Design Team as the selection panel. The competition was initiated in November 1990, so the selected individual would be available to participate in the pretests and have time to develop the necessary manuals and training program before the pilot survey. Members of the Survey Technical Committee identified a list of potential candidates. Selected companies and individuals were contacted to determine their interest in the project. Packages describing the survey and requirements of the position were sent to ten individuals. Three responses were received. Interviews were conducted with each of the three candidates to assess their supervisory skills, computer literacy, transportation background and previous experience with telephone surveys. The Survey Technical Committee confirmed the appointment of Mr. R. Ian C. Fisher on December 11, 1990.

Exhibit 2.2.1
Abbreviated Summary of Survey Content

Household Questions

1. Was the advance letter received?
2. Is the address information correct and sufficient?
3. Is it a house or an apartment?
4. How many people are in the household?
5. How many vehicles are available for personal use in the household?

For Each Person

6. Age?
7. Sex?
8. Do they have a valid driver's licence?
9. Are they employed full time or part time?
*10. If employed, where do they work (address, building, home or intersection)?
*11. If employed, do they have free parking available at work?
12. Are they a full or part time student?
*13. If the person is a student, what is the name of the school that he/she attends?
14. Did they make any trips the previous weekday?
15. If yes, from where did they start their first trip?

For Each Trip

16. What was the destination (address, building or intersection)?
17. What was the purpose of the trip?
18. What time did they start the trip?
19. What mode(s) of transportation was(were) used?

For Each Trip Made By Public Transit

20. Which transit routes were used (maximum 5)?
21. How did they access the first route?
22. If the method of access was an automobile and the first route was on the subway or GO rail, then at which station did they board?
23. How did they get from the last route to their destination?
24. If the method of egress was an automobile and the last route was on the subway or GO rail, then at which station did they alight?

* Questions which were not in the 1986 survey.

Questions subsequent to number 7 were not asked of any person under the age of 11.

2.2.3 Pretests

Three pretests were carried out to test and refine both the operation of the DDE software and the text of the questions. The first pretest was carried out in December 1990, prior to the selection of the Chief Supervisor. Environics Ltd., a leading market research company which carried out the 1986 pilot survey, was contacted and requested to perform the pretests. The pretest involved four interviewers, selected for their experience in pretesting survey questionnaires, and two evenings of interviewing. Twenty-two interviews were successfully completed out of sixty-four attempted household contacts. No advance letters were mailed out. A debriefing session was held with the interviewers at the end of each evening. In addition to meeting with the members of the Survey Design Team, the Field Manager from Environics supplied the Survey General Manager with written comments derived from the debriefing sessions and general observations made during interviews.

In addition to the field testing by Environics Ltd., a copy of the software was supplied to Tranplan Associates where Mr. Toivo Rukholm, the General Manager of the 1986 survey and, Mr. David Crowley, a member of the Steering Committee and prime instigator of the 1986 survey, performed their own independent evaluations. Mr. Rukholm and Mr. Crowley also met with members of the Survey Design Team and supplied them with written comments on the pretest.

The second pretest was carried out in February 1991. The purpose was to test changes made to the software as a result of the first pretest and to obtain some measure of the productivity which could be expected. The tests were again carried out by Environics Ltd., using four interviewers for four evenings of interviewing. Unlike the first pretest, advance letters were mailed to the households selected in the sample. Summary statistics from the second pretest are given in Exhibit 2.2.4. The number of completed interviews (93) was substantially less than the target of 120, causing concern that hourly completion rates assumed in the survey proposal would not be achieved. As a result, plans for the main survey were amended to include thirty interviewer stations instead of twenty-five. A further review of the survey content was carried out with the expressed goal of increasing the interviewer productivity rate from 3.10 completions per hour up to 3.25. The decision to drop questions on parking cost and auto occupancy was a direct result of this review.

A third and final pretest was carried out in June 1991. The main purpose of this pretest was to verify that changes made to the DDE software were working correctly prior to the pilot survey. The final pretest was also used to establish and test the format of the database for use by the coding software. The pretest was conducted by the Chief Supervisor and one interviewer working out of the Data Management Group offices for a period of one week.

2.2.4 Pilot Survey

The pilot survey was conducted out of the Data Management Group offices in July 1991. The purpose of the pilot was to test the integration of all components of the survey including, sample control procedures and the coding software. Interviewing was carried out for a three week period. An advertisement for interview staff was placed in a local Toronto newspaper. Five interviewers were selected with the intention that they would become the supervisors and training staff for the main survey. A total of 817 interviews were completed at an average completion rate of 3.27 per interviewer hour.

Exhibit 2.2.4 - Summary Statistics From the Second Pretest

HOUSEHOLD STATISTICS

Total Number of Completions: 93

Address Changes:	5 (Yes)	88 (No)
Received Mailing:	65 (Yes)	28 (No)
Dwelling Type:	48 (House)	45 (Apartment)

No. of Calls to Complete Interview:

Number of Calls	Households
1	47
2	24
3	14
4	6
5	1
6	0
7	1
8	0

Household Size:	Maximum	7
	Minimum	1
	Average	2.63
Number of Vehicles:	Maximum	3
	Minimum	0
	Average	1.23

PERSON STATISTICS

Total Number of Persons: 245

Respondent:	93 (Yes)	152 (No)
Gender of person:	123 (Female)	120 (Male)
Driver's Licence:	136 (Yes)	109 (No)

Age of Person (in years):	Range	Number of Persons
	1-10	41
	11	1
	12	3
	>12	194
	Refused	6

Status of Person:	Employed	Student
Full time	124	26
Part time	20	14
Not Employed	59	163
*Under 11	42	42

*Not asked if child's age is <11 years.

Exhibit 2.2.4 - Summary Statistics from the Second Pretests (cont'd...)

PERSON STATISTICS (cont'd...)

Availability of Free Parking at Work:	87 (Yes)	
	53 (No)	
	4 (Refused/Don't Know)	
Employment Location:	Street Address	78
	No Usual Place of Work	1
	Refused/Don't Know	1
	Non-Address	69
	A. Monuments	15
	B. Intersections	48
	C. Municipality	1
School Location:	School Name (Lookup)	34
	School Name (Defined)	3
	Street Address	1
	Missing/Blank	2

TRIP STATISTICS

Total Numer of Persons With Travel Information: 163 (Maximum =203)
Total Number of Trips Collected: 512

For those who made trips (613 persons) the following data were collected:

Average Trips/Person (with trips):	3.14	
Maximum Trips per Person:	13	
Minimum Trips/Person:	2	
First Origin Location:	162 (Home)	1 (Work)

Destination Purpose:	Code	Total Number of Trips
	Home	209
	Work	152
	School	28
	Facilitate Passenger	22
	Market	37
	Entertainment	25
	Personal	21
	Refused/Don't Know	18

Primary Travel Mode:	Code	Total Number of Trips	
	Drive	287	(56%)
	Passenger	42	(8%)
	Transit	132	(26%)
	Walk	41	(8%)
	Cycle	2	
	Schoolbus	4	

Exhibit 2.2.4 - Summary Statistics from the Second Pretests (cont'd...)

TRIP STATISTICS (cont'd...)

Primary Travel Mode:	Code	Total Number of Trips	
	Taxi	2	
	Refused/Don't Know	2	
Drive Trips: 287	With Passenger	73	(25%)
	Maximum Occupancy	5	
	Average Occupancy	1.39	
Cycle Trips: 2	School	1	
	Home	1	
Walk Trips: 41	Work	7	
	School	8	
	Home	18	
	Entertainment	1	
	Personal	4	
	Market	3	

Transit Trips: 132	Access Mode	Egress Mode
	Walk (122)	Walk (124)
	Cycle (2)	Cycle (0)
	Drive (3)	Drive (3)
	Auto Passenger (2)	Auto Passenger (2)
	Refused/Don't Know (3)	Refused/Don't Know (3)

Number of Links	Number of Trips
1	35
2	47
3	27
4	16
5	4
Refused/Don't Know	3

Total Number of Transit Routes:	294
Total Number of Routes by Lookup:	244
Total Number of Routes Defined:	50

2.2.5 Interview Manual

An interview manual was produced as a reference guide for use by both interviewers and their supervisors. The guide used in 1986 was employed as a starting point and edited before and after each of the pretests and the pilot survey. The final version of the interviewer's manual is available as a separate appendix.

2.2.6 Interview Premises

The option of having a market research company supervise all the field work was precluded at an early stage. In the evaluation of the 1986 survey, significant differences were identified in the data collection requirements for a travel survey when compared with most market research surveys and opinion polls. In some cases, the previous training of market research interviewers could be detrimental in the context of a travel survey. In the 1986 survey report, it was recommended that, "Future surveys should not necessarily rely on the market research industry to carry out the field work." In particular, a transportation background was regarded as essential in the selection of the Chief Supervisor, as well as the fact that he/she should have direct control over the interviewers. The use of the DDE and sample control software was an added complication that dictated direct control of the field work by those involved with the software development.

Several options were considered for the location of the main survey, including contracting with a market research company and the rental of private office space for the duration of the survey. The final decision was to conduct the survey from the University of Toronto using space provided by the Department of Civil Engineering.

Discussions were held with two market research companies regarding the provision of surplus space and phone lines for use in the survey. In both cases, space was limited and additional phone lines (possibly involving a complete phone system) would have been required. The services of a market research company were rejected for these reasons, as well as inconveniencing survey project staff and potential conflicts in the recruitment of interviewers. Management staff from one market research company did not want the travel survey interviewers paid more than their own staff - a direct conflict with the need already identified by the Survey Technical Committee to pay a premium to recruit good staff with both computer keyboard and interviewing skills.

Estimates were in the neighbourhood of $20,000 to rent and furnish private office space in the downtown Toronto area for the conduct of the survey. The University of Toronto's Department of Civil Engineering offered to facilitate office space for the same amount of money and to provide the necessary furnishings. Use of the university facilities offered several significant advantages relative to the other options:

- Sufficient space (about 1,400 square feet) was provided in a single location to accommodate thirty interviewers, four supervisors, a separate coding area, a meeting area and private office for the Chief Supervisor

- Space was available for setup before the survey and, for as long as needed, after the survey

- Access to an existing phone system

- The location, across the street from the Data Management Group offices, was convenient for staff working on survey preparations

- Close proximity to the Toronto subway

2.3.0 Sample Design

Primary objectives of the survey identified in the survey proposal were:

a) to obtain time series information on global trends in travel behaviour (trip rates, modal split, trip lengths etc.) and;

b) to update the 1986 origin-destination database in geographic areas where significant population changes had occurred.

The proposed sample plan was a target completion of interviews with 5% of all households in the high growth areas and a 0.5% of households in other areas. For time series analysis, the 1986 and 1991 data would be independently expanded to represent the total population in each of those years. To obtain the updated origin-destination data, it was proposed that only the 1991 data be used in high growth areas. In the low growth areas, the 1991 data would be combined with the 1986 data and expanded to represent the total number of households in 1991. The Sample Design Team evaluated and implemented the plan by undertaking the tasks outlined in the following section.

2.3.1 Strategy Evaluation

In order to ensure the appropriateness of the basic sampling plan contained in the original proposal, three basic strategies for the collection of future survey data were evaluated:

Option 1 - A 5% global sample every 10 years with a mid-point update stratified by high and low growth areas (i.e., as proposed for the 1991 survey).

Option 2 - A 5% global sample every 10 years with annual small sample surveys.

Option 3 - An annual update of survey data. Data more than 5 years old is discarded and replaced by data from a new survey. Each new survey would be stratified geographically to bring the total combined sample, collected over 5 years, up to the 6% level in all areas.

The latter two options have the advantage of providing continuous annual time series data. A continuous process of data collection and analysis was also expected to prove more cost efficient in the long term. However, in the opinion of the Survey Technical Committee, these advantages were more than outweighed by the following factors favouring Option 1 as originally proposed:

1. A large database, collected at one point in time, is more effective for cross-sectional analysis, model development and general research. Time series analysis was seen as being of secondary importance by most agencies.

2. A stable database (not updated annually) is desirable for efficiency and consistency between studies.

3. For most agencies, it would be impractical and unnecessary to update the inputs to their modelling processes more than once every five years (ten years for municipalities with a large stable population).

The Survey Technical Committee concluded that the proposed sampling plan was the most appropriate option as a base for future surveys. For consistency with the 1986 survey, a decision was made to lower the target sample in high growth areas from 5% to 4.5%.

The one major area of concern which remained was the integration of the 1986 and 1991 data, in particular, how well the data represented employment distribution and trip destinations. Because the sampling unit is the household, stratification of the sample can only occur at the home end. Areas experiencing high employment growth will draw trips from new and existing residential areas. Consequently, areas of high employment growth may be under-represented and conversely, old well-established areas, over-represented in the database. Although identified as a potential problem, the Sample Design Team was unable to suggest any practical solution in the sampling process. Analysis of the results is required to determine impacts of the potential bias created and the corrective measures needed.

2.3.2 Fringe Area

In 1986, the boundary of the survey area was chosen to coincide with the outer boundaries of the six regional municipalities participating in the survey. Trip data were collected for external trips made by households within the survey area, but no information was obtained on trips coming into the area from households outside the survey area. The GTA is a substantial net attractor of trips from surrounding areas and in 1986, there was a significant under-reporting of travel movements adjacent to the boundary. Thus, in order to meet the planning needs of communities inside, but adjacent to the 1986 survey area, the 1991 survey area was expanded to include a "fringe". The original proposal recommended the fringe be sampled at the same rate as the high growth areas (i.e., 5%), with a target of approximately 3000 completed interviews.

An analysis of 1986 Census place of work and place of residence data was performed to determine appropriate criteria for the boundary of the fringe area. Exhibit 2.3.2a shows the number of cross-boundary work linkages from adjacent areas in decreasing order of their proportion of the total labour force of the community. Analysis of the data revealed communities adjacent to the 1986 survey boundaries, within a 10 to 20 km radius, account for 50% of the total cross-boundary work linkages. The Survey Technical Committee, therefore, decided the fringe would consist of a band approximately one municipality deep surrounding the main survey area. For sample selection, it was necessary to define the area by means of rural postal codes (as shown in Exhibit 2.3.2b) which do not necessarily correspond to municipal boundaries. The total fringe area is slightly smaller than that area encompassed by the municipalities listed in Exhibit 2.3.2b. The smaller area, together with a

Exhibit 2.3.2a
1986 Cross Boundary Work Linkages

Municipality	Labour Force	Employed in GTA	%	Estimated Sample (5%)
Tottenham	1342	853	63.6	643
Bradford	4328	2654	61.3	140
Adjala	2057	1226	59.6	63
Manvers	1920	1101	57.3	68
Erin Township	3342	1819	54.4	99
Beeton	1056	572	54.2	35
West Gwillimbury	2325	1259	54.2	67
Erin	1233	650	52.7	39
Grimsby	8375	4131	49.3	282
Mariposa	2625	1287	49.0	89
Tecumseh	3496	1690	48.3	100
New Credit	24	10	41.7	1
Cookstown	426	176	41.3	19
Mono	2312	875	37.8	68
Onondaga	739	263	35.6	21
Orangeville	7199	2428	33.7	237
Haldimand	8285	2759	33.3	292
West Lincoln	4716	1540	32.7	147
Hope Bay	1696	521	30.7	59
Innisfil	5561	1508	27.1	247
Aaranth	1517	403	26.6	41
East Grafraxa	896	235	26.2	28
Mulsur	1086	261	24.0	35
Eldon	843	198	23.5	39
Alderville	61	14	23.0	3
Melancthon	1031	229	22.2	34
Millbrook	312	68	21.8	18
Tosorantio	1616	351	21.7	51
Eramosa	2543	542	21.3	74
Cavan	2135	399	18.7	66
Lincoln	6844	1269	18.5	235
Belmont & Methuen	855	158	18.5	44
Shelburne	1219	214	17.6	52
West Luther	471	81	17.2	16
Port Hope	4711	790	16.8	191
TOTAL	89197	32534	36.5	3041

Exhibit 2.3.2b
Fringe Area Postal Codes

Hamilton Fringe

Grimsby	All of forward sortation area L3M		
Caistor Centre	L0R 1E0	Grassie	L0R 1M0
Smithville	L0R 2A0	Caledonia	N0A 1A0
York	N0A 1R0	Branchton	N0B 1L0
Glen Morris	N0B 1W0	St. George Brant	N0E 1N0

Halton Fringe

Arkell	N0B 1C0	Eden Mills	N0B 1P0
Morriston	N0B 2C0	Puslinch	N0B 2J0
Rockwood	N0B 2K0		

Peel Fringe

Orangeville	All of forward sortation areas L9V and L9W		
Laurel	L0N 1L0	Ballinafad	N0B 1H0
Erin	N0B 1T0	Hillsburgh	N0B 1Z0

York Fringe

Bradford	All of forward sortation area L3Z		
Beeton	L0G 1A0	Bond Head	L0G 1B0
Bradford	L0G 1C0	Bradford	L0G 1G0
Loretto	L0G 1L0	Tottenham	L0G 1W0
Churchill	L0L 1K0	Cookstown	L0L 1L0
Gilford	L0L 1R0		

Durham Fringe

Port Hope	All of forward sortation area L1A		
Bethany	L0A 1A0	Campbellcroft	L0A 1B0
Millbrook	L0A 1G0	Pontypool	L0A 1K0
Janetville	L0B 1K0	Little Britain	K0M 2C0
Manilla	K0M 2J0	Oakwood	K0M 2M0
Woodville	K0M 2T0		

subsequent reduction in target sample (from 5% to 4.5%), allowed the sample allocation for the fringe to be reduced from 3000 households to 2300.

A significant proportion of the total cross-boundary work linkages are from large urban centres outside the GTA with Guelph, Brantford, Barrie, St. Catharines, Cambridge and Kitchener making up 25% of the total. However, in these areas, the proportion of the labour force working inside the GTA was much lower ranging from 2% in Kitchener up to 9.3% in Barrie. To have included any of these areas in the fringe would, therefore, have been an expensive and inefficient method of data collection on cross-boundary travel.

With respect to distance (12 km) and the proportion of its labour force working in the GTA (16.8%), the Town of Port Hope was marginal in meeting the criteria for inclusion in the fringe. The inclusion of Port Hope also represented a significant addition to the target sample for the fringe area (191 households). Therefore, Port Hope was sampled at half the rate of the rest of the fringe for a target of 100 completions, which is expected to be sufficient to produce a statistically valid profile of commuters using the Highway 401 corridor into the GTA.

2.3.3 Sample Frame

The design of the survey assumed the same methodology that was used in 1986 - a telephone interview preceded by a letter explaining the nature of the survey. The methodology dictated the sample frame be households having telephones and the logical source to obtain the sample information would be Bell Canada. The 1986 sample was obtained directly from Bell Canada Marketing Research and consisted of an extraction of names, addresses and phone numbers derived from their residential billing files. In 1991, the information had to be obtained from Teledirect, a subsidiary of Bell Canada, and was extracted from the current listings in the phone directory. The different source resulted in three differences in the sampling frame:

1. The billing address is not always the same as the location of the phone. Therefore, the 1986 sample included some phones which were outside the survey area (cottages, etc.). The 1991 sample frame was superior in this regard.

2. Households with multiple phone lines usually have a separate listing for each line in the phone directory, but in some cases, have a single billing record. Duplication of these households is more likely to occur in the 1991 sampling frame than in the 1986 survey sample.

3. Market Research surveys usually require that sample be drawn at random from within the defined sample frame. This method of sampling was employed by mistake in the 1986 TTS survey. The 1991 survey used the preferred sampling technique for travel surveys which is to extract every nth record after the sampling frame has been geographically sorted. The advantage of this technique is it ensures uniform geographic coverage even at a detailed level. In addition, households with multiple phone lines would not be sampled more than once since their listings will be consecutive.

These differences are not expected to affect any comparison of results between the two surveys. Both sample frames excluded unlisted phone numbers. The 1986 survey included an analysis of the distribution of unlisted numbers using aggregate data supplied by Teledirect Canada. It was concluded that their exclusion would not cause a significant bias in survey results. In both cases, the geographic area to be covered by the sample frame was defined in terms of postal codes.

Two samples were obtained. The first was purchased from Teledirect in June 1990. This sample consisted of a 1% sample of phone listings within Metropolitan Toronto, and a 4% sample of listings for the surrounding area extending beyond the fringe. The sample was used in both the pretests and pilot survey and assisted in the analysis and definition of the high growth and fringe areas.

The sample for the main survey was purchased in June 1991, and consisted of every 10th phone listing from the sample frame sorted on postal code, street name and street number. The following postal codes were included:

Everything beginning with the letter M
Everything beginning with L0 except L0S
Everything beginning with L1 and L3 through L9 (L2 excluded)
Everything beginning with N0A, N0B, N0E and the following individual rural codes:

K0K 1C0	K0K 2E0	K0L 1B0	K0L 1E0	K0L 1V0
K0L 2W0	K0L 2X0	K0M 1A0	K0M 1B0	K0M 1E0
K0M 1G0	K0M 1K0	K0M 1L0	K0M 1N0	K0M 1T0
K0M 2B0	K0M 2C0	K0M 2J0	K0M 2M0	K0M 2T0

The resulting sample obtained from Teledirect consisted of approximately 170,000 records of which 146,700 were contained solely within the survey area excluding the fringe.

In 1986, some problems and delays were experienced in obtaining the sample from Bell Canada. No problems occurred with the 1991 samples. Both of the 1991 samples were obtained within a few days of being requested and were exactly in accordance with the survey specifications.

2.3.4 High Growth Areas

High and low growth areas were defined in terms of estimated population change between 1986 and 1991 at the traffic zone level. The following procedure was used:

1. Percentage growth was calculated for each zone using census data for 1986 and the Ministry of Transportation's and Metro Toronto Planning Department's most recent population forecasts for 1991.

2. Zones were sorted in descending order of percentage growth.

3. The cut-off point (17% growth) was identified where approximately 20,000 interviews would need to be completed to yield a 4.5% sample in areas with higher growth and 0.5% in the remaining areas.

4. In the sample selection process, households were assigned UTM coordinates and then to traffic zones by means of postal codes. In areas with rural postal delivery service (all addresses with a "0" as the second character of the postal code), households in the sample selection process were allocated to the zone containing the post office which served that address. Aggregate boundaries of the high and low growth areas were reviewed and modified, such that the entire area served by one post office was designated as entirely high growth or entirely low growth.

5. The selection of high growth zones was further reviewed by each of the regional municipalities and modified where appropriate. Some high growth zones remote from any urban centre were eliminated. In areas where there were concentrations of high growth zones, other zones were added to make the definition of the high growth area more contiguous.

The above selection procedure was tested in the pilot survey using the sample obtained from Teledirect in June 1990. The final review and selection of the high growth areas was carried out in July 1991, based on the sample purchased for the actual survey.

2.3.5 Sample Selection Procedure

All households in the sample obtained from Teledirect were geocoded to UTM coordinates using a Postal Code Conversion File obtained from Statistics Canada. More than a 99.9% match was achieved between the postal codes in the sample and those contained in the conversion file. To validate the accuracy of the coordinates contained in the postal code conversion file, two tests were undertaken. Accuracy was important both with respect to the stratification of the sample and to the acceptability of using postal codes as the basis for geocoding the final survey data. In the first test, coordinates of all postal codes in the postal code conversion file were compared with the boundaries of their forward sortation areas. The coordinates were defined in a forward sortation area boundary file supplied by Statistics Canada. Due to anomalies discovered in the boundary file, a total of 12,861 households (5%), were identified as not located in the correct forward sortation area. The boundary file obtained from Statistics Canada was created in 1986 and there are no immediate plans to review or update it. The results of the test were, therefore, inconclusive.

In the second test, a batch process was used to assign UTM coordinates from the AMF to each record in the Teledirect sample using the actual address information contained in the file. These coordinates were then compared with those given by the postal code conversion file. Only 30% of the household records could be successfully geocoded using the batch process. Of these households, more than 98% were within 1 km of the postal code coordinates. The conclusion drawn from this test was that postal code coordinates were adequate for sample selection and control, but for the final database, households should be geocoded to the actual household address location.

In the original 10% sample, coordinates for households within the main survey area were used to assign each household to a traffic zone. The zones were grouped into 164 sample control areas keeping the high growth zones separate from the low growth zones. In the fringe area, postal codes were used to identify households and to assign them to one of thirteen additional sample control areas. A new sample file was created containing all sample households in the high growth and fringe areas and every 5th household of the 10% sample in the low growth areas. A random number was assigned to each household and the file was sorted by random numbers within each sample control area. As new sample was needed, households were drawn sequentially from the appropriate control area.

2.3.6 Sample Control

A target number of completed household interviews was established for each sample control area. The target for high growth areas was set at 5.4% of the total number of households as estimated from the 10% sample obtained from Teledirect. In low growth areas, the target was set at 0.6% of total households. These rates were obtained by adding a 20% contingency margin to the desired 4.5% and 0.5% completed sample rates.

The sample control was carried out at two levels. The sample control areas were grouped into six macro control areas (MCAs) with an approximately equal number of target interviews to be completed in each. The sample was administered separately for each MCA. The number of completions were controlled manually through the number of interviewers assigned to each MCA.

At the individual sample control area (SCA) level, the sample was controlled by the sample control software. The rate of sampling for each SCA was automatically adjusted each time a new set of labels were generated for the advance mailing of letters to the selected households. The adjustment was based on the number of completed interviews in the SCA relative to the total target. The adjustment procedure is explained further in the sections covering quality control and the sample control software.

2.4.0 Publicity

The pretests and the pilot survey were carried out without any publicity other than an advance letter sent to selected households. Publicity for the main survey included a bilingual press release and a letter to local government and public service officials in both official languages.

2.4.1 Letter to Local Officials

Exhibit 2.4.1 is a copy of the letter sent by the Survey General Manager, advising local officials of the conduct of the survey. One month prior to the start of the survey, this notification letter was sent to the following officials within the GTA:

- Federal and Provincial Members of Parliament
- Regional Chairmen
- Mayors
- Police Departments

2.4.2 Press Release

A week before the start of the main survey, press release packages were sent to all newspapers, television and radio stations in the survey area. The package contained the following items:

- A news release, Exhibit 2.4.2a, explaining the need for and the scope of the survey
- A general fact sheet, Exhibit 2.4.2b, containing data from the 1986 survey
- A copy of the advance letter, Exhibit 2.4.3, mailed to survey participants
- Sample pages from the TTS Summary Report, produced from the 1986 survey

The news release and fact sheets were provided in both official languages.

In addition to the written material, television stations were provided with a silent video tape with clips of transit vehicles, cars and people in a variety of transportation related settings. The Survey Technical Committee had hoped the clips, overlaid with the stations' own commentaries would be used in local television news broadcasts. Because of competing news stories, few stations, if any, made use of the clips.

2.4.3 Advance Letter

A separate version of the advance letter, Exhibit 2.4.3, was printed for all household samples of each region with the signature of the appropriate regional chairman. All versions carried the signature of the Ontario Minister of Transportation. For residents of the fringe area, a general version of the letter was used bearing just the Minister's signature.

The advance letter was regarded as a critical item in the conduct of the survey, in terms of both encouraging a high response rate and in minimising the amount of time interviewers needed to spend explaining reasons for the survey. The letter was prepared by the chairman of the Publicity Team and reviewed by all members of the Survey Technical Committee before submission to the Deputy Minister's, Minister's and Regional Chairmen's offices for approval. The approval process was initiated two months prior to the start of the survey in order to ensure adequate time for the subsequent printing of all letters. A total of 55,000 letters were printed, twice the maximum target for the number of interviews to be completed. This number was based on the 60% overall completion rate achieved in 1986. Standard Ontario Ministry of Transportation envelopes were to be used for all mailings.

The inclusion of a trip log, to be filled out by all members of the household on the day before the interview, was considered and rejected. This approach had been tested as part of a pilot project prior to the 1986 main survey. A higher trip rate was reported for people who filled out the log than for those who did not complete the form, but obtaining this additional information proved to be a costly venture. The most serious drawback was the low incidence (22%) with which people actually used the log. Another problem was the administrative overhead associated with coordinating the timing of the mailing, the date on which the data was to be recorded and the interview itself. Finally, a fundamental concern with the 1991 survey was the need for a consistent methodology with the 1986 survey in order to be able to make valid time series comparisons.

3.0 Software Development

One of the major differences in the conduct of the 1991 survey from the 1986 survey was in the area of automation and software development. Automation was applied to nearly every aspect of the 1991 survey including sample selection and control, interviewing, geocoding and quality control. In order to provide consistency in software development and to minimise file conversions and transfers, all software was written using FoxPro v1.02 and were run on stand-alone IBM compatible systems. The major software components were the sample control software (SCS), the direct data entry (DDE) program and the geocoding software.

Exhibit 2.4.1
Letter Advising Officials of the
1991 Transportation Tomorrow Survey

THE TRANSPORTATION TOMORROW SURVEY

Dear Sir/Madam:

I am pleased to announce that a major travel survey will be conducted in your community between early September and mid-December.

The survey will consist of a telephone interview of a randomly selected sample of the households in the Greater Toronto Area. Sponsored by the Ontario Ministry of Transportation, the Toronto Transit Commission and regional municipal councils, the survey will cover Metropolitan Toronto and the regions of Durham, Halton, Hamilton-Wentworth, Peel and York. Some local communities immediately adjacent to the above areas will also be included. A pilot survey was conducted earlier this year in selected areas.

The survey's purpose is to collect information on the travel habits of residents and provide a database for long-range planning and improvement of road and transit facilities. A similar survey was conducted in the fall of 1986. In addition to trip information for each household member (i.e., trip origin, destination, time, purpose, means of travel), survey participants will be asked about age, sex, employment status, size of household and number of motor vehicles.

All information collected will be kept in the strictest confidence and cannot be traced to an individual household. Only combined results for an entire area will be examined to determine travel patterns for specific communities.

Enclosed is a sample of the notification letter which will be sent to each household chosen for telephone interviews. Separate press kits have been prepared to notify the general public through regular television and cable channels, as well as local and regional newspapers.

If you have any questions about the survey, please contact the Transportation Demand Research Office at the Ministry of Transportation at (416) 235-4090 or 1-800-268-0637 between 8:30 a.m. and 4:30 p.m. or myself at (416) 987-6773.

Sincerely,

P. M. Dalton

Peter Dalton
General Manager

Exhibit 2.4.2a
News Release of the 1991 Transportation Tomorrow Survey

THE TRANSPORTATION TOMORROW SURVEY

NEWS RELEASE

FOR IMMEDIATE RELEASE
September 3, 1991

Transportation Tomorrow Survey 1991 begins September 5

TORONTO -- The Ontario government is participating with Greater Toronto Area municipalities on a survey designed to determine local transportation choices that will help them plan for the future.

Ontario Transportation Minister Gilles Pouliot today announced that the Transportation Tomorrow Survey 1991 will examine the travel habits and preferences of residents of the Greater Toronto Area. The survey will help in the planning of road and transit improvements, and provide information for long-term planning.

The survey will involve the Regions of Durham, Halton, Hamilton-Wentworth, Peel and York; Metropolitan Toronto, the Ministry of Transportation and the Toronto Transit Commission.

"This survey will help us better respond to each community's needs," said Pouliot. "The population of the Greater Toronto Area, including Hamilton-Wentworth, is expected to grow to 6 million people in the next 20 years. We need to plan now for improvements to our transportation system that will allow it to meet the increased requirements."

The first Transportation Tomorrow Survey was conducted in 1986. More than 60,000 interviews were conducted in the Greater Toronto Area (one in every 25 households), including Metro Toronto, Durham, Peel, Halton, York and Hamilton-Wentworth.

Information gathered in the 1986 survey was used to plan a wide range of transportation activities in the Greater Toronto Area -- including the Let's Move rapid transit expansion program, Highway 401 expansion and development of Highway 407.

...../2

The survey consists of a telephone interview to 30,000 randomly selected households. In addition to trip information for each household member (i.e. origin, destination, time, reason for travel, mode of transportation), interviewers will also ask age, number of vehicles available for personal use and where each member works or attends school.

The survey is being conducted by the University of Toronto's Data Management Group, hired to develop and implement the survey and gather results.

Used for statistical purposes only, all information will be kept strictly confidential and cannot be traced to the individual household. Once the study is complete, the survey results will be released in 1992.

- 30 -

For further information, please contact:

Peter Dalton
University of Toronto
Data Management Group
(416) 978-6773

John Cooper
Communications Branch
(416) 235-4877
or 1-800-268-0637
Fax: (416) 235-4841

Exhibit 2.4.2b

TRANSPORTATION TOMORROW SURVEY 1991

FACT SHEET

Dates: September 5 to mid-December 1991

Hours: 5 p.m to 9:45 p.m during weekdays
10 a.m. to 5 p.m Saturdays

Languages: English, French, Italian, Portuguese and Cantonese

One in every 50 households in the Greater Toronto Area (including Metro Toronto, the Regions of Peel, Durham, Halton, York and Hamilton-Wentworth) will be contacted.

Survey Questions

All the questions asked will relate to trips made by members of each household. Sample questions are outlined on the back of the letter sent to all selected households (sample enclosed). All information is confidential and will only be used in combination with other households to determine general travel trends. No individuals or households will be identified.

Travel Trivia from 1986 Survey

Total households in the Greater Toronto Area	1,470,000
Average household size	2.8 persons per household
Lowest vehicle ownership	Metro Toronto at 1.22 per household
Highest vehicle ownership	York Region at 1.89 per household
Average vehicle ownership	1.41 per household
Total trips	8.8 million daily in the GTA

14% of all households did not have a vehicle.
23% of all trips made were to work with a similar number returning home or travelling to other destinations from work.
62% of the total population of 4,063,000 were licensed to drive.
18% of all trips were made by transit.
72% of all trips were made by automobile.
9% of all trips were made by walking or bicycle.
1% of all trips were made by other means such as motorcycle.

Exhibit 2.4.3
Advance Letter for the 1991 Transportation Tomorrow Survey

THE TRANSPORTATION TOMORROW SURVEY

We are conducting an important survey which will help us meet your community's needs for roads and transit services. The purpose is to collect information on the travel choices and preferences of people in your area.

A similar survey in 1986 demonstrated that people were travelling farther and more often than ever before. The demand for both roads and transit services was growing twice as fast as the population. The 1986 survey resulted in a commitment of more than $7 billion for transportation projects which you indicated were needed. Those projects are now being implemented.

We need your help to update the information from this earlier survey so we may continue to plan for the future.

Here's how it works: You will be telephoned at home by a professional interviewer and asked to spend about 10 minutes answering questions. The interviewers will call some time in the next two weeks. On week nights, the calls will be made between 5 p.m. and 9:45 p.m. If the interviewer calls on a Saturday, it will be between 10 a.m. and 5 p.m.

Please inform other members of your household that you have received this letter and to expect our telephone call.

Most of the questions will focus on travel by members of your household on the weekday before the call. We would like to know specific information about where and when trips were taken by all members of your household. This information will allow us to develop an accurate picture to plan improved transportation services and facilities in your area. A sample list of the questions to be asked is shown on the back of this letter.

All information will be kept strictly confidential. No information will be released in such a way that it could be traced to your household. However, the combined responses from all the interviews should shed new light on what is needed.

If you have any questions, please call the Transportation Demand Research Office of the Ministry of Transportation at 235-4090 or 1-800-268-0637 between 8:30 a.m. and 4:30 p.m. on weekdays.

We would like to extend our personal thanks for your assistance in this project. Your help means better roads and better transit in the future.

Yours sincerely,

Alan Tonks
Chairman
Municipality of Metropolitan Toronto

Gilles Pouliot
Minister of Transportation

Ontario

A survey conducted for:
the Regions of Durham, Halton, Hamilton-Wentworth, Peel and York;
Metropolitan Toronto, Ministry of Transportation
and the Toronto Transit Commission.

Exhibit 2.4.3
Advance Letter for the 1991 Transportation Tomorrow Survey (cont'd...)

SURVEY QUESTIONS

A. About your household

- Type of building (house or apartment)
- Number of people
- Number of vehicles available for personal use

B. About each person

- Their age
- Do they have a driver's licence?
- Where do they work or go to school? (exact street address preferred, please)

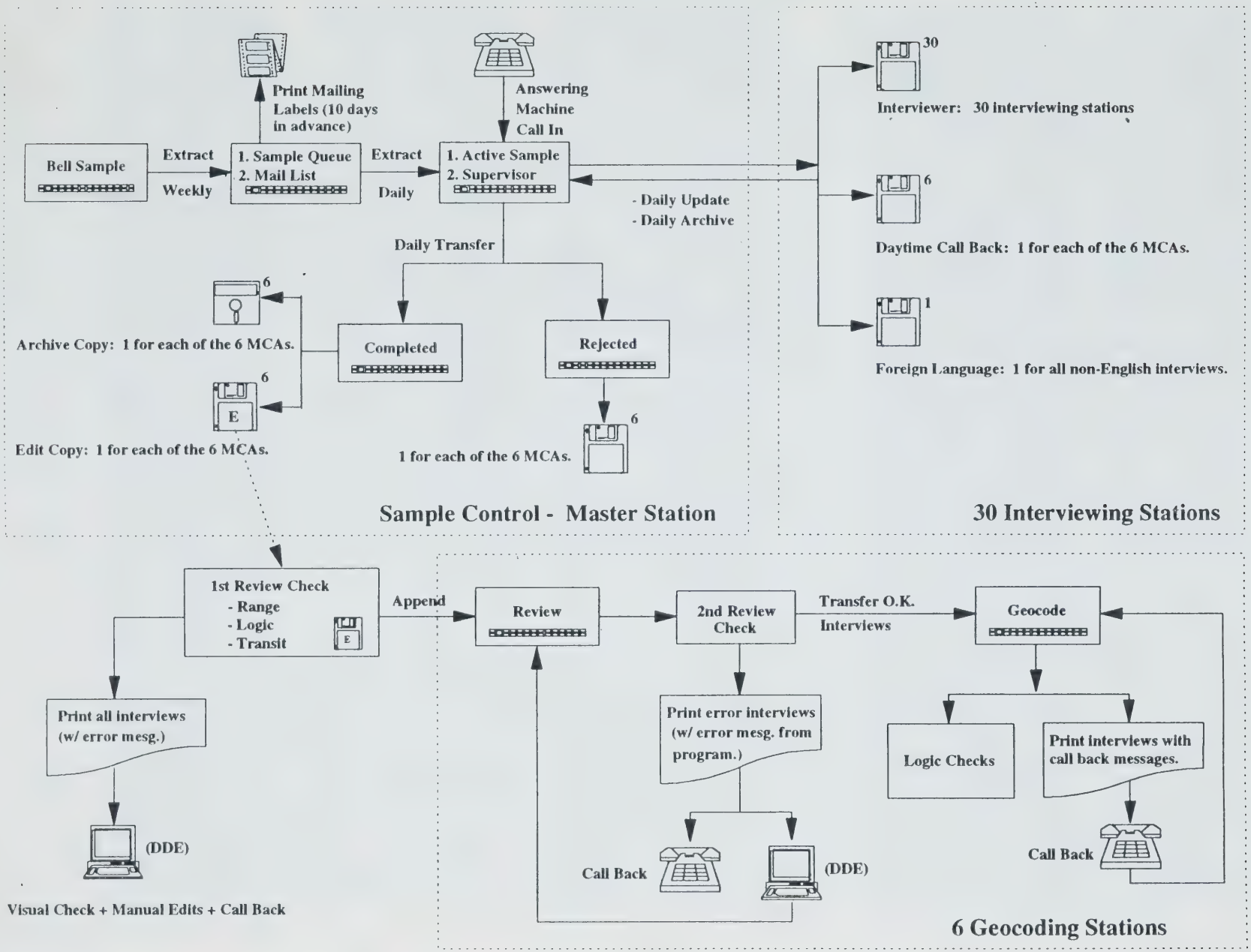
C. About each trip made by each person the previous day

- Where from and to? (street address, building name or intersection)
- Reason for making the trip (e.g. , shopping)
- Start time
- Mode of transportation (bus, car, bicycle, etc.)

We will only be collecting trip data for persons 11 years of age or older. A trip is a one-way journey from one location to another by any form of motorized transportation or bicycle. We will request some information on walking, but only for trips to and from work or school.

Authority for collection of this information has been obtained from each of the Regional governments participating in this survey. Confidentiality of this information is protected under the Freedom of Information and Protection of Privacy Act.

Exhibit 3.1.0 - Data Flow Diagram



3.1.0 Overview

The overall computer system was comprised of one master sample control computer, thirty interviewing computers and six geocoding computers of which three were used for both interviewing and geocoding. The sequence of events and how data moved through the system is illustrated in Exhibit 3.1.0. Stored in the master station were the Teledirect sample file and the SCS. In addition to performing sample selections (i.e., sample queuing and generating mailing labels), the master station also kept a complete history of every household sampled. This included all call histories and data regardless of the household's completion status. Interview samples were transferred to the interviewing computers on diskettes. There were three types of interviewing diskettes: the normal interviewer diskette, the daytime call back diskette and the non-English speaking household diskette. Interview diskettes were updated daily on the master computer. Completed interviews were grouped into six files by their master control areas (MCA) and passed onto the first review program by diskette. After the first review check, a hard copy of each interview was printed for visual checks, and edits were performed directly on diskettes using the DDE program. When the edited interviews were appended to the database on geocoding computers, they passed through a second review check program. Any household that failed the second check was printed again for review and those without errors were transferred for geocoding.

3.2.0 Direct Data Entry

One of the recommendations from the 1986 survey was the use of a Direct Data Entry (DDE) system. Instead of manually recording survey information on paper and later inputting the information into a computer file, the interviewer enters information directly into a computer while conducting the interview. Advantages of a DDE system is twofold. First, DDE eliminates the need for data entry after the interview is completed, saving time and effort, as well as minimising data entry errors. Second, having the interview in electronic format enhances the efficiency of sample and quality control. During the planning stage, it was unclear whether a DDE system would speed up or slow down the actual interview. However, it was demonstrated that with proper training, DDE proved to be a more efficient system that outperformed traditional paper and pencil recording techniques.

The DDE software is written in FoxPro v1.02 and runs on a stand-alone IBM compatible system in compiled executable format. The minimum computer configuration for satisfactory operation is a 286-16 MHz computer with 1 MB of RAM and a high speed 20 MB hard disk. Initially, it was planned that the DDE software would run from an XT type computer. However, with the addition of on-line checking routines and pop-up browse windows, a faster computer was required. Technically, DDE's operating speed is directly related with the amount of available RAM and the speed of the hard disk. A decision was reached to carry out the interview on stand alone computers instead of on local area network (LAN) because of the lack of experience on LAN and the fact that DDE itself is a new technology to travel surveys.

Key features of the system include an integrated household sample selection and control capability, a built-in interview script, and cross-referencing of information. The data verification features include on-line logic and range checking and "look-up lists" for verification of key items, including school names, transit routes, municipalities and street names. These latter were incorporated in such a way as to both minimise key strokes and ensure high accuracy rates.

There are two operating modes for the DDE software, a normal interviewer and a supervisor

mode. In the normal interviewer mode, the software automatically selects which household to interview. The system also carries through the interview in a systematic order, collecting first all household information, then person and finally trip data.

3.3.1 Sample Selection and Control

At the beginning of every interview session, each interviewer received a sample group of households on a floppy diskette. The sample was generated by the sample control software running on a central sample control and data processing machine. The sample issued to each interviewer consisted of households with three different interview status levels, those with a scheduled call back time, those with prior unsuccessful attempts to make contact (e.g., no answer) and those with no prior contact history. This sample file was first copied from the floppy diskette to the hard disk of the PC being used by the interviewer, and subsequent work was performed directly from the hard disk. To avoid loss of information, information was saved onto the hard disk at the end of each data field entry during the interview and the complete file was copied back onto the floppy diskette at the end of each interview.

The DDE software automatically sequenced the households for the interviewer by first drawing households with scheduled call back times, followed by the physical order of the households in the sample file. There were two types of scheduled call backs: those set by the interviewer and those that were automatically set by the DDE software. An interviewer scheduled a call back if a household requested to be interviewed at a later date and time, or if additional information was to be provided at a later time. Automatic call backs were set by the DDE software if an interviewer encountered a busy signal, no answer or an answering machine.

An interviewer was also able to specify which particular household to interview or review. There were two ways to specify a household. An interviewer could either select one of the previous interviews he/she had worked on earlier, or a supervisor logged into the system and could specify a household by its telephone number. In fact, households which responded to the call in message left on answering machines were extracted using this supervisor login method. In both login modes (normal or supervisor), the DDE software kept a record of the person working on an interview. The login name of the last person that edited any information and the first person who collected travel information for the household were saved on the interview record.

3.3.2 Working Screens

Every screen is divided into three sections. Relevant information collected during the interview is constantly updated and displayed at the top portion of the screen. For example, on the trip data screen, the person's name, age, sex, home and work addresses are shown while collecting trip information. The middle portion of the screen is the active area where the interviewer keys in the required information. Full screen editing capability is available in this middle section. The bottom section of the screen contains instructions to the interviewer including the interviewer script for the current data item, available options and valid response codes. Pop-up windows are used whenever a long message is to be read aloud by the interviewer, for example when explaining the background and purpose of the survey, or leaving a message on an answering machine. Function keys are used

to jump from one screen to another for quick editing and review. Most responses are subjected to logic and/or range checking. In cases where the keyed data was in error, a warning message was displayed, and the interviewer was instructed to either change the keyed entry, or confirm that it is the accurate response.

There were five main working screens: (1) household selection screen, (2) household data screen, (3) person data screen, (4) trip data screen and (5) transit data screen.

1. Household Selection Screen

The household selection screen is the first screen presented to the interviewer after logging into the system. Interviewers may choose to either interview the next household or review a previously interviewed household. For a supervisor, there are two additional options, the choice of selecting a specific non-English speaking household, or selecting a household by its telephone number. After making a choice, the DDE software locates an appropriate household in the interview sequence, or the household specified by the user. The household's family name, address and telephone number were then displayed, along with information about any previous contact attempts. This contact history includes the time and date of previous calls, the reasons for having to call back (such as no answer, line busy, answering machine encountered, or incomplete interview) and any memo messages left behind by previous interviewers. These memo messages can be reviewed or edited at any time during the interview. The objective is to familiarize the interviewer with the household as much as possible before contact is made.

Using a series of messages, the selection screen guides the user through the process of contacting the appropriate household, finding out if they received the pre-survey mailing informing them of the purpose of the survey, and determining if they are willing to participate at this time. If so, the interview proceeds to the household data screen.

2. Household Data Screen

Household information collected during the survey, includes confirmation of the household's address, the dwelling type, the number of household members and the number of vehicles available for use. The language used for the interview is also indicated by the interviewer in this screen. If the household indicated a preference to be interviewed in a language other than English, the interviewer would terminate the interview, indicating to the software that a call back was desired by someone with skills in that language. During the 1991 survey, this feature was used to successfully complete other foreign language interviews, such as French, Cantonese and Italian.

The information collected in the household screen, specifically the number of people and the number of vehicles available, sets logical and sequence conditions for the collection of person and trip information.

3. Person Data Screen

Person information is collected for one person at a time. Personal information for each

member in the household is collected before the individual travel information. Person data includes the person's name or some other identification label (such as "mother", "father" or "respondent") age, sex, possession of a driver's licence, employment and student status, and the person's usual place of work and/or school if applicable. Work and school addresses are entered as a street address, an intersection or a monument name. Monument names are identifiers for particular buildings, landmarks or attractions. This information is verified as it is entered using the "look-up lists" described below. The availability of free parking at work is asked if the person is employed. Employment, student and trip information are not collected for persons aged 10 and under.

4. Trip Data Screen

The aim of the TTS was to sequentially reconstruct the complete one day travel activities of each person in the household. To accomplish this task, the interviewer established whether each person made any trips on the travel day. This travel day was usually the weekday previous to the day of the survey. The time period of interest on the travel day was from 4:00 a.m. on the travel day until 3:59 a.m. the next morning. If trips were made by an individual, the information collected was the first origin of the day and all subsequent trip destinations.

Trip end points are entered as a street address, intersection or monument. This information is again verified using the "look-up list" feature. Because a person's daily trip activities are often made up of their home, work and school locations, trip destinations can also be specified with a home, usual place of work, or usual place of school choice. The address information collected in the household and person data screens are automatically transferred to the trip records. This feature not only speeds up the interviewing process, it also eliminates duplication of effort during geocoding, and eliminates a potential source of errors.

In addition to collecting origin-destination locations, trip purpose, start time and mode of travel were also recorded. The start time is checked to ensure that trips are being recorded sequentially. If the mode of travel is auto driver, the software checked for the possession of a driver's licence and the availability of a private vehicle.

The trip data screen contains the most information of all the working screens. Not only does it display the current person's personal and trip information, it also shows the same trip information for all other members of the household. If several members of the household travelled to the same location, a simple copy command can duplicate an entire trip. Full screen editing capability is available so that any trip record can be edited. However, only trips for the current active person can be inserted or deleted.

5. Transit Data Screen

One of the requirements of the survey was to collect detailed routing information for transit trips. Thus, a special screen was designed solely for these trips. The transit data screen is activated when public transit is specified as the mode of travel. In addition to collecting individual transit routes, access and egress modes to and from transit are also recorded. When the first or last roue is GO (commuter) rail or subway and the access or egress mode is auto driver, auto passenger or taxi, the transfer station name is also recorded. On-line

transit coding is performed by providing "look up lists" of transit routes and station names to the interviewer. Transit routes are searched using their formal or alias names or by their route number. Every route is also checked for connectivity with the previous route. Because a commuter will often use the same routes to go back to their initial origin, an option to reverse a previous transit trip's routings is made available to the interviewer.

3.3.3 Look-Up Lists

Providing on-line, detailed lists of helpful information on different working screens is one key to the smooth operation of the DDE system. It reduces key strokes while enhancing data quality by minimising spelling errors and ensuring that a description complete enough to allow accurate geocoding has been recorded. For example, when recording a street, it is important that its street type (such as "Avenue", "Road" or "Court") and direction (such as "East" or "West") are also recorded. Because there are a large number of streets with similar or exact names in the municipalities within the study area (the worst being "King Street"), it was also important to have the interviewer confirm the correct municipality for the street address.

The listings are presented in pop-up "browse and select" windows. There are a total of five browse and select windows for listings of municipality, street, school, transit route and transit station look-ups. All of these windows operated in two ways. First, as the interviewer enters information, the software searched for a unique match in the reference database. If the information entered reaches the point where there is a unique match in the look-up list, the software displays the match and prompts the interviewer to confirm that this is the correct entry. The interviewer can either accept the match or override the selection and continue to input the rest of the information. Second, after entering the first few letters, the interviewer can press "Enter" to bring up a list of all the entries in the look-up list which matches the letters typed so far. The list appears in a pop-up window, and the interviewer can scroll through the list to select an entry. This feature is particularly useful when the information being entered is lengthy, difficult to spell or if the interviewer expects a short list of matches. If no entry in the look-up list matches the typed letters, the software automatically displays a box where the interviewer can type in the rest of the name. A summary of these five browse and select windows is outlined in Table 3.3.3.

3.4.0 Geocoding

The concept of geocoding is to assign X and Y coordinates to geographic locations. An advantage to this is that data can be used in subsequent analysis in both aggregated and disaggregated forms. Furthermore, aggregation may also be performed on any alternative zone system simply by defining the coordinates of new zone boundaries. Since the 1986 Transportation Tomorrow Survey, geocoding has been applied to every major survey conducted in the GTA.

The geocoding system developed for the 1991 survey is very similar to the one used in the 1986 survey. The software devised in 1991 can be run in batch or interactive mode and contains a set of look-up files (street addresses, monuments, intersections and places, such as towns and postal districts) making reference to the UTM six degree coordinate system. The coordinates are in 1/10 of a meter, that is, seven digits for the X coordinates and eight digits for the Y coordinates. The geocoding software is written in FoxPro v1.02 and runs in a compiled executable format on stand alone IBM compatible systems.

Table 3.3.3
General Summary of Browse and Select Windows

WINDOW NAME	WINDOW CONTENTS
Street	Includes a listing of Greater Toronto Area (GTA) and Grimsby streets sorted by name, type, direction and area municipality. Where there were two or more streets with the exact same description within a municipality, they were differentiated by hamlets. Selection of a street also determined the municipality name.
Municipality	In addition to the 36 area municipalities in the GTA, entries also included names of local postal districts and hamlets, both inside the GTA and in the fringe area surrounding the GTA.
School	All public, private, separate schools and post-secondary institutions in the GTA and Grimsby were included in this window. Individual campuses were listed for all post-secondary institutions. The list was sorted by school name and area municipality.
Transit Routes	Transit routes were searched by their formal name, alias name or route number. The list contained both the route and the operator names and included inter-city transit properties, as well as some privately operated shuttle services.
Transit Station	GO Rail and TTC subway stations were presented in separate listings.

3.4.1 Choosing the Operating System

During the planning stage of the survey, the Coding Team evaluated two alternatives for the development of the geocoding software. The first alternative was to make use of the geocoding software initially developed for the 1986 survey using MTO's Convergent Technologies (C.T.) computers. The software had been modified several times and tested through a number of other travel surveys. With few modifications and new reference databases, this system would have been ready for use. The second alternative, adopted by the Coding Team, was to re-write the geocoding software using DOS software. Because of the popularity of DOS, this option offered more flexibility in terms of future development and general use. Furthermore, the cost, availability and speed of PC's also offered a more attractive alternative to the MTO's CTOS equipment. A substantial amount of research was spent on the development of a geocoding program using MapInfo and MapCode. MapInfo is a useful tool in displaying spatial information (i.e., street networks and other physical features). Mapcode provides the capability to customize query commands and look-up functions. However, because MapInfo and MapCode are not database management software, the test coding program was slow to operate and the cross-referencing of files and records were rigid and difficult to program. Based on this finding, the Coding Team decided to forego the graphic capability and concentrated on the development of a pure database management software for geocoding. FoxPro v1.02 was later chosen to be the programming base for the geocoding software because of the following reasons:

1. Both the DDE and SCS are written in FoxPro for MS DOS. Writing the geocoding software in FoxPro helps maintain consistency in software development and minimise file transfers.

2. FoxPro is a relational database management system. This allows the coder to have access to all information belonging to a household.

3. The operating speed of FoxPro is directly related to the performance of the computer. By using 386 computers with 2 MB RAM, geocoding look-ups were almost instantaneous.

4. FoxPro files can be imported directly into MapInfo. Therefore, even though geocoding was in FoxPro, MapInfo was utilized for solving geocoding problems graphically.

3.4.2 Reference Database

In any geocoding project, the reference database is perhaps the most crucial and time consuming to construct. The geocoding software makes use of four sets of reference databases: one postal code file, one monument file, three street address files and two place name files. The total disk storage is about 60 MBytes.

1. Postal Code Conversion File

The postal code conversion file is a detailed computer file which provides the centroid coordinate for every available postal code. This was used for batch coding of home addresses in which the street address look-up had failed and the postal code had been coded to the block-face level (i.e., mainly in the urban areas). Though some mistakes were found in the conversion file, the postal code file was a reliable source for the coding database.

2. Monument File

To identify a particular location, it is common to use a monument name instead of a street address. A monument may be a building or landmark, such as the CN Tower or the Eaton Centre. The Coding Team examined two approaches to the design and content of the monument file. One was to modify monument records created during the 1986 survey by appending a small number of new monuments to the 1986 survey file. The second approach was to create a new file by using local municipalities' assessment files as the main base. Other sources of information would include listings from the Yellow Pages and business directories.

A final decision was reached to use the 1986 monument file as the base for the 1991 survey for the following reasons:

1. The registered owner's name in the assessment file may not be the common name of the property. This is especially true for numbered companies. Furthermore, companies are individually listed for shopping plazas and malls.

2. The property address in the assessment file may not be complete in order to geocode using the Area Master File since the street descriptions may vary from those records in the Area Master File. Therefore, the assessment records would require some manual geocoding.

3. The assessment file was too big and too detailed for practical use. Instead of accelerating the geocoding process, it was expected that having too many choices on the selection screen would slow down the process.

4. With the exception of schools, less than 25% of the geocoding work was expected to be of monument look-ups.

The task of revising the 1986 monument file was given to each of the regional municipalities. The aim was to reduce the file by deleting entries with unreliable coordinates and multiple entries with spelling errors. The final product was about 1/3 (19,000 records) of the original size. To enhance the file listing, a list of all public, private, separate schools and post-secondary institutions was obtained from the Ministry of Education. Lists of Ontario hospitals were acquired from the Ministry of Health, and listings of registered daycare centres were obtained from the Ministry of Community and Social Services. These were also added into the base monument file. During the course of the survey, another 500 monuments were added bringing the final monument file to approximately 21,500 records.

3. Place Name Files

Every location within the Greater Toronto Area and the Town of Grimsby was to be coded to the block-face level, and other locations to the "place name" level. This was done in order to achieve the accuracy needed for the survey. The place name file contains the names and city hall coordinates of municipalities, cities, hamlets and local districts for Ontario and was obtained from the Ministry of Transportation. This file was divided into two, one for places inside and one for places outside the GTA and Grimsby. The numbers of records in these files are approximately 1,800 and 18,000 respectively. The file for GTA place names also included the addition of local postal district centroids.

4. Street Address Files

An Area Master File (AMF) is a digital data file which defines the complete street network and other features within a specific geographic area. The AMF makes reference to street name, address range, intersecting streets and block-face centroid coordinates. A pre-census copy (January 1991) of the AMF was obtained from Statistics Canada for the whole survey area with the exception of the Town of Caledon which came directly from the Regional Municipality of Peel. In order to implement the AMF, a number of file manipulations were performed:

a) The AMF was organized by local municipalities. This resulted in a number of street entries having the same name within the same municipality. Furthermore, because arterial roads in Metropolitan Toronto may span several local municipalities, they were recorded as separate entries in the AMF. In order for street look-ups to be more efficient, effort was spent to delete duplicate entries and distinguish streets with identical names within the same municipality by hamlets.

b) Centroid coordinates and address ranges were recorded in the AMF by block-faces. A block-face is defined as one side of a city street between consecutive intersections

with streets, physical feature(s), start points or end points. Therefore, a block-face may be a straight or curved segment along an arc of a street. The length of block-faces on the opposite sides of the street are not necessarily the same. This is particularly true for streets with a T-intersection.

For the survey, block-faces were further divided into straight line segments where there was a change of direction, or an intersection with another street or a physical feature on one or both sides of the street. Centroid coordinates were re-calculated to the midpoint of the segment with a 22 metre setback from the centre-line of the roadway. Address ranges were interpolated where necessary.

c) The AMF was divided into three look-up files as follows:

Table 3.4.2
Look-Up Files Within the Area Master File

FILE	DESCRIPTION	RECORDS
Street	Streets were sorted by name, type (i.e., avenue, boulevard, etc.), direction (i.e., east, west, etc.) and area municipality. When two or more streets have the same name, type and direction description, they were differentiated by the hamlet to which they belonged.	28,000
Address Range	Each street was broken into straight line segments between intersecting streets or physical features or where there was a change of direction. Address ranges and centroid coordinates on both sides of the street segment were listed.	134,000
Intersection	An intersection is defined as the centre point where two streets intersect. They were indexed by the names of the two streets. Street type and direction were not part of the index because it is unlikely that there were two or more sets of streets of the same names that intersected within the same area municipality. For streets such as a crescent and circle, the coder was required to chose any one of the intersecting points. This was a drawback, but intersection responses were discouraged in favour of actual addresses and monuments to minimise potential geocoding problems.	106,000

3.4.3 Batch Processing

Survey records were batch processed in two stages. Stage 1 withdrew records from the DDE software and prepared them for geocoding, Stage 2 performed the actual batch geocoding work.

1. Preparing for Geocoding

In order to geocode a given location, it was often necessary to edit the address information collected to match that in the reference databases. The batch program made duplicate copies of the address description collected by the interviewer to ensure the original information was not lost. It was this duplicate copy that was used for geocoding and editing by the coder.

Since trip-ends were often repeated for the same person, not every location description was unique and required geocoding. For example, a home may also be the person's place of work, first origin of the day, and also the last destination of the day. By flagging the trip's location type as home, usual place of work or usual place of school, the number of locations requiring geocoding decreased significantly.

The third task was to process only those locations which required geocoding and to determine the kind of location information collected by the interviewer. Location flags were set based on whether the location description was a street address, an intersection or a monument. For home addresses, there was also a flag to indicate whether a postal code was available for postal code matching. If a hamlet or postal district name was entered, the program changed their location to the area municipality where they belonged. Furthermore, from the area municipality name, the program determined whether the location was inside or outside of the GTA and Grimsby.

2. Batch Geocoding

Based on location flags, the batch program attempted to match both the survey record and reference database. If a unique match was found, the program used the coordinates from the reference database and flagged the record as being successfully coded. Otherwise, the batch process flagged the record according to the look-up failure (e.g., multiple choices found, street or monument not found or address out of range). These flags assisted the manual coder in understanding the nature of the coding problem.

3.4.4 Interactive Geocoding

The coder's login name determined which of the two modes the interactive program operated in - a normal coder mode and a supervisor mode. In normal coder mode, the program brings up one record at a time that requires geocoding. In supervisor mode, the coder specifies which record to access for geocoding or review. In either mode, the program keeps track of the person working on each record and will only allow editing of the address information on the duplicate copy.

Geocoding was accomplished in two ways. The first was used when a problem was easily recognized, such as typing errors or misspelt entries. In this case, the coder corrected the information and activated the program for an automatic look-up of the information. The second method is called the Browse and Select Method. The coder specified a search condition (i.e., a street or monument

name) and the program returned a list of possible choices in a pop-up window the coder then scrolled through the list and made an appropriate selection.

A coder may also flag any record that he/she cannot geocode. These flags are: (1) Don't Know, (2) Refer to MapInfo and (3) Call Back Required. A "Don't Know" flag is warranted when the given information is insufficient to pinpoint an exact location and the survey respondent has refused to be more specific. This would include responses such as, "Downtown Toronto" or "Bank of Montreal" without specifying which branch. A "Refer to Mapinfo" flag is used to identify a location which is on a local street map, but is not covered by the AMF. The same record may be geocoded graphically by selecting a point on the screen in MapInfo at a later time. A "Call Back Required" flag is used when the coder requires further clarification of a location. The coder leaves a call back message on any household record that has a problem. This message is then printed with the complete interview. After obtaining the information needed from the household, the coder simply recalls and completes the record in supervisor mode.

Table 3.4.4
Summary of Browse Windows

TYPE	SEARCH OPTIONS	WINDOW CONTENTS
Street Name	Street name, type, direction and area municipality	All streets which match the search condition. This window is for reference only and does not perform any geocoding functions.
Address Range	Street name, type, direction and area municipality	Includes street block-faces with address ranges, centroid coordinates and intersecting streets, if applicable.
Intersection	Street name, type, direction and area municipality of one street	All streets which intersect with the specified street. UTM coordinate is for the centre-point of the intersection.
Monument	Monument name and type, hamlet or area municipality name	Any monument names specified by the search condition of a certain monument type (e.g. hospital, school, mall).
GTA + Grimsby Place Name	Place name	A list of all places with a centroid coordinate and area municipality name which meet the search condition. Although this window allows geocoding, it is mainly used for reference. This is because GTA and Grimsby places are to be coded to the block-face level.
External Place Name	Place name	A list of all places with centroid coordinates which meet the search condition.

4.0 Equipment

The DDE software was specified to run on stand alone MS-DOS computers, instead of a multi-user system, in order to eliminate the risk of a total system failure during interviewing. Stand alone computers also guaranteed performance specifications regardless of the number of interviews being conducted simultaneously. Consideration was given to the use of other computer platforms (UNIX and Convergent Technolgy's CTOS) for the coding software, but were rejected in favour of MS-DOS due to anticipated lower development costs and better staff support for a common platform for all components of the survey.

4.1.0 Computers

The following computer equipment was acquired for the conduct of the survey. Performance specifications are a reflection of both the tasks to be performed and the timing of the purchase of the equipment in a rapidly changing computer technology market. All units were acquired with drives for 3 1/2 inch high density diskettes, had standard VGA graphics cards and 14 inch colour monitors. The sample control and coding computers also had 5 1/4 inch drives.

- In June 1990, one 80386/20 MHz processor with 4 megabytes of memory, 650 megabyte hard disk drive and a tape cartridge unit for backup was obtained.

The above unit was purchased as the sample control computer used to prepare the sample and to process the data collected on a daily basis. The computer was also used for sample analysis, software development and software testing prior to the survey. The unit was retained after the survey for analysis of the data. The disk drive was subsequently transferred to an 80486/50 mhz processor.

- In December 1990, three 80386/25 MHz processors each with 4 megabytes of memory and a 125 megabyte 24 millisecond hard disk drive were bought.

These were purchased and used exclusively for coding during the main survey, but were also employed for interviewing during the pretests. They were resold after the survey.

- In July 1991, three 80386/33 MHz processors each with 2 megabytes of memory and a 105 megabyte 19 millisecond hard disk drive were acquired.

During the survey, these units served a double purpose being used for interviewing in the evenings and for coding during the day. After the survey, the computers were retained for analysis of data with their memory upgraded to 4 megabytes each.

- In August 1991, seven 80286/20 MHz processors each with 1 megabyte of memory and a 50 megabyte 19 millisecond hard disk drive were purchased.

These units were used exclusively for interviewing and were resold after the survey.

- Also in August 1991, twenty 80386/25 MHz processors each with 2 megabytes of memory and a 50 megabyte 19 millisecond hard disk drive were bought.

These units were purchased through an agreement with the Department of Civil Engineering at the University of Toronto. During the survey, the computers were used for interviewing and upon completion of the survey, to re-equip the Departments' microcomputer laboratory.

4.2.0 Telephones

Setting up a phone system to conduct a major survey was a complex process involving four separate components: the phones themselves, the phone system, the access lines and long distance calling provisions.

While Bell Canada is generally the sole provider of the phone access lines, there are a number of other suppliers of phone systems and phone equipment with a wide range of different features. Bell Canada has a variety of discount packages on long distance services and there are other companies which have equipment to intercept long distance calls and route them through their own network. Any person setting up a phone system to do surveys would be well advised to consult an independent telephone specialist.

Four basic options considered for the survey were:

1. Installation of separate business phone lines for each interview station

2. Installation of a separate phone system with the specific features required for the survey

3. Connection to the existing university phone system

4. Connection to the Government of Ontario phone system at Queen's Park

The last option was selected because of the significant cost savings it offered. The Government of Ontario has its own intercity network of phone lines used for long distance calls. The projected savings in long distance calling charges were estimated at $14,000. Due to the survey hours being in the evening, no conflict arose with the normal business use of the intercity network.

The major disadvantage of using the Government network was that the phone system would not allow supervisors to tap into and monitor interviews already in progress - a feature regarded as essential for interviewer training and quality control. The same problem would have existed with the university phone system. The only option which would have provided this capability was the installation of a separate phone system at a cost of at least $20,000.

A partial solution to the monitoring problem was found in conjunction with the headset units used by the interviewers. All interviewers were provided with telephone headsets in order to permit two handed keyboard operation. The headsets operated with an adjustable amplifier that had a second output jack used by supervisors to monitor calls. For convenience, extension wires were run from the jacks to a central panel which allowed a supervisor to plug into any one of nine phones. Calls could not be monitored if the interviewer used the telephone handset instead of the headset.

Thirty phone lines were installed for interviewers and four for supervisors. The supervisors' lines were requested before it was known that they could not be used for monitoring of phone calls. They were subsequently used by coding staff for call backs and as reserve lines for interviewing.

4.3.0 Visual Monitoring Equipment

One of the concerns with the DDE software was the need to monitor information being entered into computers for quality control purposes. Traditionally, in a paper and pencil survey, supervisors fill out their own copy of the survey questionnaire form while monitoring ongoing interviews. The supervisor then compares the answers he or she has recorded with the answers recorded by the interviewer. With the Direct Data Entry procedure, no hard copy is generated and copies of the interview are not immediately available. Consideration was given to a procedure whereby an interviewer's diskette could be seized at any time for printing of the completed interview(s). This option was rejected in favour of electronically monitoring the interviewer's screen. The monitoring equipment used connects to the monitor output from each interviewer's computer. The supervisor is able to choose which interviewer to monitor by means of a master control panel. Used in conjunction with the telephone monitoring system, the supervisor was able to visually monitor data being entered, at the same time, listening to the interview. The visual monitoring equipment had another advantage. Output from one computer could be transferred to one or more of the other screens, a useful feature in training.

The supplier of the equipment provided four units free of charge for evaluation in the pretests. The Department of Civil Engineering agreed to purchase a master control station and five monitoring units for future use in their microcomputer laboratory. The survey was allowed to use the equipment in return for purchasing and contributing another four monitoring units. The nine monitoring units and a supervisor were set up with one of the four banks of phones. Interviewers were assigned to those stations during initial training and afterwards, on a rotational basis.

5.0 Conduct of the Survey

5.1.0 Hiring of Interviewers

Interview staff were recruited by means of a help wanted advertisement in a local newspaper (the Toronto Star) and by personal referrals from other interviewers. Typing or keyboarding skills and previous telephone marketing or market research experience were stated prerequisites. The Chief Supervisor initially screened potential candidates by phone. Applicants who claimed to have the required skills and were able to demonstrate a pleasant telephone manner, were invited to attend an interview. Applicants were interviewed individually by the Chief Supervisor who used the occasion to brief the applicant about the survey and to demonstrate the DDE software. Suitable candidates were invited to attend further training sessions and were given a copy of the interviewers' manual to study before the first training session.

A special effort was made to recruit interviewers who were able to conduct interviews in other languages in addition to English. The four languages identified from the 1986 survey as being the most likely to be needed were French, Cantonese, Italian and Portuguese. One interviewer fluent in French, two in Cantonese and one in Italian were recruited without difficulty. It was not possible to recruit an interviewer fluent in Portuguese. The numbers of people interviewed and trained are shown in Exhibit 5.1.0.

5.2.0 Training

Interviewer training sessions lasted for three evenings and were held in groups of three to five people each. The training program started two and a half weeks before the survey with the five interviewers hired for the pilot survey acting as trainers and supervisors. During the initial start up period, three groups were trained a week with one group each starting on Monday, Tuesday and Wednesday, so that there were a maximum of three groups being trained on Wednesday evenings.

The first evening of training consisted of a detailed demonstration of the software by the Chief Supervisor. The trainees then conducted interviews with each other and with the training staff, usually with one trainer assigned to two interviewer staff. The trainers would simulate a variety of interview situations in their responses, in order to familiarize the trainees with all aspects of the interview and DDE software.

The second evening began with a review of the software features followed by more interview practice. When ready the interviewers would start doing live interviews over the telephone using a "training" sample, which was not part of the survey. Households in the training sample had received the same advance letter sent to households in the survey sample and were not aware they were not part of the main survey. Trainers performed over the shoulder monitoring of interviews until they felt that the trainee was ready to proceed on their own.

On the third night, trainees were assigned to stations with electronic monitoring equipment. Interviews with the training sample continued until the Chief Supervisor felt the trainee was proficient enough to start interviewing with the actual survey sample. Some interviewers were prepared for live interviews on their second night while others were not. All the interviewers had to undergo live interviewing on the third night of training and if the interviewer was not capable of conducting the interview, they were then let go.

New groups were not trained on Thursday or Friday allowing the supervisors to perform intense monitoring of the new interviewers during their first two or three days of live interviewing.

5.3.0 Rates of Pay

Interviewers were paid $8 per hour for an initial two week period including training. On satisfactory completion of the two week, "Probationary" period, they were paid between $9 and $12 an hour depending on their performance. Four measures were used to rate the performance of each interviewer.

1. Productivity

   The average number of household interviews completed per hour of paid interviewing time.

2. Trip Rate

   The average number of trips for which trip data were collected per person in the completed households.

Table 5.1.0
Number of Interviewers

Replies to Advertisement	170
Invited to Be Interviewed	90
Invited to Be Trained	80
Completed Training	72
Resigned or Were Dismissed (in First Few Days)	8
Subsequently Resigned For a Variety of Reasons	20
Final Roster Total	**44**

Note: 3 members of the final roster were students and only able to work a maximum of 2 nights a week due to the pressure of school work.

3. Refusal Rate

The proportion of households contacted that refused to participate in the survey.

4. Call Back Rate

The proportion of interviews recorded as complete that were later identified as requiring a call back for clarification because the information collected was insufficient or inconsistent.

The above information was monitored daily, much of it electronically. Once a week, a formula was applied to rank the performance of all the interviewers. The performance statistics were posted for all interviewers to see. Any increases in rates of pay for subsequent pay periods were tied directly to performance in the previous pay period. The distribution of rates of pay is shown by week in Exhibit 5.3.0. The average rate of pay for interviewers, at $10.30 per an hour including incentive bonuses, was about 20% higher than rates normally paid to telephone interviewers by the Market Research industry in Toronto (typically $8 - $9 an hour in 1991).

Supervisors were paid $11 an hour for the first two week period, and then $12.50 to $14 an hour depending on merit. The average pay was $12.62 an hour.

At the beginning of the survey, interview staff were paid bi-weekly on the Friday following the end of the pay period. Many of the interview staff were students, or had other jobs, which only allowed them to work two or three evenings a week. The pay period was changed to weekly when it was observed that a significantly higher number of interviewers were working on pay days than on any other day. The pay day was also changed to Thursday in the hope of encouraging a higher turn out on that day.

5.4.0 Incentive Bonuses

At the outset of the survey, it was recognized that it might be desirable to have some additional incentive bonus introduced mid-way through the survey to raise morale and to give added encouragement for trained staff to stay until the end of the survey. The incentive plan was announced to staff at the end of October and commenced the week beginning November 11, 1991. Two separate bonuses were offered with the primary objectives of encouraging longer work hours and eliminating the need to train new interviewers between then and the end of survey.

1) Interviewers were paid $1.50 extra for each hour worked in excess of 14 hours in one week.

2) A bonus of $1 per hour after completion of 600 interviews, rising to $2 per hour after 900 completions and $3 per hour after 1200 completed interviews.

The two bonuses were applied together so that it was possible for an interviewer to be earning as much as $16.50 an hour for a few days at the end of survey. Prior to implementation, it was projected that the bonus scheme would cost between $1500 and $2000 in addition to the normal interviewers' pay. A summary of bonus hours and costs is given in Table 5.4.0. The total amount paid in bonuses was $1,413, approximately 2% of the total payroll cost for interviewing. There was little turnover of staff subsequent to the introduction of bonuses.

Exhibit 5.3.0 - Rates of Pay by Interviewing Hours

Status	Rate ($/Hour)	Pay Period Ending Date												Cost ($)
		Sep-14	Sep-28	Oct-13	Oct-20	Oct-27	Nov-03	Nov-10	Nov-17	Nov-24	Dec-01	Dec-08	Dec-15	
Interviewers	8.00	440.00	213.50	463.00	141.00	8.00	13.00	33.00						1312.00
	9.00		396.00	280.50	123.00	260.25								1080.00
	9.50			96.00	36.00	70.00	106.80	123.30	58.80	46.00	26.00	16.00	14.00	593.00
	10.00			155.50	60.00	51.00	118.00	77.10	53.60	68.00	51.00	39.00	46.00	719.00
	10.50				63.00	88.75	125.50	104.00	113.80	68.00	45.60	39.80	14.00	662.00
	11.00			67.50	24.00	83.00	112.60	138.30	70.00	88.80	63.30	56.30	69.50	773.00
	11.50													227.00
	12.00			48.00	21.00	35.00	115.30	97.30	168.30	151.50	143.30	113.80	92.00	986.00
	12.50								20.10	24.80	15.00	26.30	26.00	112.00
	13.00								30.00	48.00	54.10	73.10	112.00	317.00
	13.50								33.90	25.00	22.90	25.10	33.50	140.00
	14.00										22.00	30.80	15.00	68.00
	14.50								9.50	13.00	13.00	11.30	26.25	73.00
	15.00												14.00	14.00
	15.50										11.00	11.00	5.00	27.00
	16.00												10.00	10.00
	Total Hours	440.00	609.50	1110.50	468.00	596.00	603.20	606.00	612.30	601.40	510.20	462.80	483.25	7103.00
	Cost ($)	3250.00	5272.00	10014.00	4355.00	5846.00	6377.00	6327.00	6930.00	6871.00	6013.15	5561.70	6068.88	72155.00
	Mean Cost ($)	8.00	8.65	9.02	9.30	9.81	10.57	10.44	11.32	11.43	11.80	12.02	12.56	10.30
Supervisors	11.00	230.00	225.50											456.00
	12.50			204.00	81.50	125.25	117.00	106.50	98.50	92.00				285.00
	13.00										94.50	106.50	105.30	306.00
	14.00			94.00	36.50	40.00	46.50	49.50	50.50	46.00				363.00
	14.50										48.00	36.00	35.00	119.00
	Total Hours	230.00	225.50	298.00	118.00	165.25	163.50	156.00	149.00	138.00	142.50	142.50	140.30	2096.00
	Cost ($)	2530.00	2481.00	3899.00	1530.00	2126.00	2114.00	2024.00	1938.00	1794.00	1925.00	1907.00	1876.00	26109.00
	Mean Cost ($)	11.00	11.00	12.97	12.96	12.86	12.98	12.98	13.01	13.00	13.51	13.38	13.37	12.62
Benefits														
	Total Cost	**6536.00**	**8383.00**	**15527.00**	**6405.00**	**8764.00**	**9363.00**	**9209.00**	**9802.00**	**9581.00**	**8745.00**	**8215.00**	**8779.00**	**109310.00**
	Completions	**1263.00**	**1563.00**	**2630.00**	**1414.00**	**2188.00**	**2252.00**	**2242.00**	**2354.00**	**2354.00**	**2188.00**	**2198.00**	**2198.00**	**24864.00**
	Unit Cost	**5.13**	**5.30**	**5.90**	**4.53**	**4.01**	**4.16**	**4.11**	**4.16**	**4.07**	**4.00**	**374.00**	**3.99**	**4.40**

Table 5.4.0
Paid Bonus Hours

Week Ending	>14 Hours/Week ($1.50/hour)	>600 Total Interviews ($1.00/hour)	>900 Total Interviews ($2.00/Hour)	>1200 Total Interviews ($3.00/Hour)	Total Cost
Nov 17, 1991	110.5	37.5	N/A	N/A	$203
Nov 23, 1991	118.5	41.0	N/A	N/A	$219
Nov 30, 1991	71.5	83.6	33.0	N/A	$257
Dec 7, 1991	70.5	128.3	37.3	N/A	$309
Dec 14, 1991	90.3	180.0	19.0	24.0	$425
				TOTAL	**$1,413**

5.5.0 Quality Control

Quality control over the information being collected was assured by the following procedures:

1) Logic checks performed by the DDE software
2) Monitoring of interviews while in progress
3) Daily performance monitoring of interview statistics
4) Daily review of completed interviews
5) Feedback from the coding process
6) Periodic rotation of interview diskettes between interviewers

5.5.1 Monitoring

For the first few nights of live interviewing, new interviewers were assigned to the interview stations with electronic monitoring equipment which were always manned by one of the supervisors or one of the representatives from the participating agencies. More experienced interviewers were asked to use the equipment periodically. The supervisors' comments were recorded in writing and discussed with the Chief Supervisor before being relayed to the interviewer. Items of particular concern were the interviewer's telephone manner and their ability to question respondents to ensure the completeness and accuracy of information. Speed and accuracy of typing were also a concern. Interviewers were warned not to lead respondents in their answers and not to readily accept refusals.

The supervisors also frequently monitored the more seasoned interviewers, but without the benefit of visual monitoring equipment.

5.5.2 Performance Statistics

The sample control software was used to print comprehensive statistics on interviews conducted by each interviewer, both daily and in a cumulative report. In addition to monitoring the productivity of each interviewer, reports facilitated immediate identification of significant differences in refusal rates, trip rates and other factors related to quality control, so that prompt corrective measures could be taken. Interviewer reports were reviewed daily by both the Chief Supervisor and the General Manager. A sample report is shown as Exhibit 5.5.2.

5.5.3 Progress Reports

In addition to the interviewer performance reports, the sample control software was used to produce daily status reports on the number of interviews completed and attempted for each sample control area. These reports were used to monitor key variables by sampling area, such as household size, trip rates, completion and refusal rates. The number of interviewers assigned to each macro control area (MCA) was adjusted daily on the basis of these reports to maintain uniform coverage. The timing and size of each mailing of advance letters was also determined from the reports. A sample report is shown as Exhibit 5.5.3.

5.5.4 Daily Review of Completed Interviews

Every interview passed through a series of review checks before being geocoded. Review checks were divided into two stages, a computer software examination and a manual visual inspection. The review software was programmed to check for completeness and consistency of interviews. Checking conditions included, but were not limited to the following:

1. The number of person records = number of household members.
2. The number of trip records = number of trips a person made.
3. Trips were recorded sequentially in terms of trip start times.
4. Work location was recorded for employed person.
5. School location was recorded for student.
6. Transit route and transfer point have valid codes.
7. Location data has complete address description.

Interviews which failed computer checks were flagged with corresponding error messages. Every interview was printed, with the necessary error messages, after the first computer check and visual inspection by interview supervisors. Corrections were made using the DDE software. If an interview required clarification or additional information, it was given back to the original interviewer for an explanation or call back. This combination of computer and visual checks was performed at least twice on every interview. The difference was that after the first review check, only those households which failed the program check again were printed for additional visual checks.

Exhibit 5.5.2 - Interviewer Performance Report for December 11, 1991

ID	Acc	Comp Inter	Total Pers	Total Trips	Ave Pers per Hsehold	Trip Rate per Person	No. Call Back	No. Ans Mach	No. Busy	No. No Ans	For	Total Incom	Bus Line	8 Att	Out of Ser	Ref	Tot Unsucc	% Unsucc of Total	Total Cont	Sam Used	Cont Rate	Comp Rate	Refusal Rate
AD	1	380	1058	2148	2.78	2.03	13	31	2	27	11	84	40	15	5	80	140	17.39	460	520	0.88	0.73	0.17
AL	1	12	41	100	3.42	2.44	0	0	0	0	0	0	0	0	1	2	3	14.29	14	15	0.93	0.80	0.14
AM	1	3	7	25	2.33	3.57	0	0	0	0	0	0	0	0	0	0	0	0.00	3	3	1.00	1.00	0.00
AR	1	348	1078	1987	3.10	1.84	16	13	0	20	4	53	24	22	12	82	140	19.07	430	488	0.88	0.71	0.19
AS	1	656	1922	4231	2.93	2.20	27	20	0	26	19	92	31	40	45	48	164	6.82	704	820	0.86	0.80	0.07
AT	1	454	1320	3288	2.91	2.49	13	6	1	18	16	54	22	19	28	36	105	7.35	490	559	0.88	0.81	0.07
AW	1	600	1892	3972	3.15	2.10	8	12	1	18	11	50	31	22	34	55	142	8.40	655	742	0.88	0.81	0.08
BB	1	12	29	93	2.42	3.21	0	0	0	0	1	1	1	0	0	3	4	20.00	15	16	0.94	0.75	0.20
BD	1	797	2266	4675	2.84	2.06	34	13	1	23	15	86	54	29	41	77	201	8.81	874	998	0.88	0.80	0.09
BK	9	315	870	2081	2.76	2.39	17	34	1	87	9	148	9	15	5	26	55	7.62	341	370	0.92	0.85	0.08
CA	1	1005	3062	6889	3.05	2.25	41	24	4	43	20	132	59	33	60	108	260	9.70	1113	1265	0.88	0.79	0.10
CC	1	48	146	297	3.04	2.03	1	0	0	2	3	6	4	1	1	7	13	12.73	55	61	0.90	0.79	0.13
CD	1	320	925	1825	2.89	1.97	3	1	0	2	9	15	29	20	18	51	118	13.75	371	438	0.85	0.73	0.14
CF	1	410	1247	2700	3.04	2.17	22	7	1	16	3	49	14	15	30	56	115	12.02	466	525	0.89	0.78	0.12
CK	1	103	310	554	3.01	1.79	2	0	0	0	0	2	4	0	4	14	22	11.97	117	125	0.94	0.82	0.12
CS	1	82	241	451	2.94	1.87	0	0	0	0	0	0	5	1	2	8	16	8.89	90	98	0.92	0.84	0.09
CW	1	328	913	1913	2.78	2.10	9	6	1	7	9	32	21	16	20	51	108	13.46	379	436	0.87	0.75	0.13
DB	1	252	685	1415	2.72	2.07	2	3	0	8	3	16	27	9	18	58	112	18.71	310	364	0.85	0.69	0.19
DH	1	37	117	268	3.16	2.29	0	0	0	0	0	0	7	1	0	9	17	19.57	46	54	0.85	0.69	0.20
DK	1	48	151	353	3.15	2.34	0	0	0	1	1	2	4	2	2	14	22	22.58	62	70	0.89	0.69	0.23
DL	1	221	681	1655	3.08	2.43	1	2	0	0	4	7	13	3	5	34	55	13.33	255	276	0.92	0.80	0.13
DN	1	385	1192	2611	3.10	2.19	31	15	0	28	4	78	35	10	7	67	119	14.82	452	504	0.90	0.76	0.15
DY	1	406	1073	2175	2.64	2.03	25	14	0	21	26	86	73	39	2	82	196	16.80	488	602	0.81	0.67	0.17
EE	1	575	1770	3656	3.08	2.07	28	14	0	17	21	80	37	21	32	68	158	10.58	643	733	0.88	0.78	0.11
EF	1	479	1405	3117	2.93	2.22	30	8	1	39	13	91	33	14	36	57	140	10.63	536	619	0.87	0.77	0.11
ES	1	577	1639	3310	2.84	2.02	11	32	4	82	49	178	34	25	60	50	169	7.97	627	746	0.84	0.77	0.08
GG	1	23	61	127	2.65	2.08	0	0	0	0	1	1	5	2	1	7	15	23.33	30	38	0.79	0.61	0.23
GM	1	579	1661	3779	2.87	2.28	23	7	1	19	25	75	64	25	20	42	151	6.76	621	730	0.85	0.79	0.07
GO	1	865	2599	5931	3.00	2.28	31	27	5	60	20	143	47	27	55	82	211	8.66	947	1076	0.88	0.80	0.09

Exhibit 5.5.2
Interviewer Performance Report for December 11, 1991 (cont'd...)

ID	Acc	Comp Inter	Total Pers	Total Trips	Ave Pers per Hsehold	Trip Rate per Person	No. Call Back	No. Ans Mach	No. Busy	No. No Ans	For	Total Incom	Bus Line	8 Att	Out of Ser	Ref	Tot Unsucc	% Unsucc of Total	Total Cont	Sam Used	Cont Rate	Comp Rate	Refusal Rate
HH	1	677	1894	4277	2.80	2.26	16	11	2	101	20	150	51	26	49	23	149	3.29	700	826	0.85	0.82	0.03
HZ	1	471	1450	3110	3.08	2.14	13	30	1	34	10	88	27	15	30	95	167	16.78	566	638	0.89	0.74	0.17
IF	9	36	91	244	2.53	2.68	0	0	0	0	0	0	0	0	1	3	4	7.69	39	40	0.98	0.90	0.08
JC	1	158	491	969	3.11	1.97	3	4	0	6	5	18	21	17	11	43	92	21.39	201	250	0.80	0.63	0.21
JG	9	116	379	825	3.27	2.18	57	15	2	22	11	107	6	11	3	30	50	20.55	146	166	0.88	0.70	0.21
JN	9	34	87	161	2.56	1.85	2	0	0	0	0	2	1	0	0	1	2	2.86	35	36	0.97	0.94	0.03
JP	1	272	823	1980	3.03	2.41	2	0	0	1	8	11	15	11	13	30	69	9.93	302	341	0.89	0.80	0.10
JR	1	428	1323	2930	3.09	2.21	8	2	0	10	13	33	31	13	31	34	109	7.36	462	537	0.86	0.80	0.07
JS	1	633	1881	3701	2.97	1.97	8	11	4	73	20	117	55	30	41	72	198	10.21	705	831	0.85	0.76	0.10
JW	1	111	283	496	2.55	1.75	2	1	0	2	16	21	28	9	38	31	106	21.83	142	217	0.65	0.51	0.22
KH	1	68	186	401	2.74	2.16	3	0	0	1	1	5	11	15	7	32	65	32.00	100	133	0.75	0.51	0.32
KM	9	385	1066	2770	2.77	2.60	22	11	4	27	7	71	16	11	2	23	52	5.64	408	437	0.93	0.88	0.06
LC	1	18	51	135	2.83	2.65	0	0	0	0	0	0	3	0	1	4	8	18.18	22	26	0.85	0.69	0.18
LK	1	345	1019	2268	2.95	2.23	7	3	0	9	27	46	50	11	37	60	158	14.81	405	503	0.81	0.69	0.15
LN	1	435	1271	2999	2.92	2.36	6	2	0	1	14	23	23	18	27	76	144	14.87	511	579	0.88	0.75	0.15
LT	1	668	2087	4098	3.12	1.96	15	18	1	16	24	74	37	17	49	54	157	7.48	722	825	0.88	0.81	0.07
MC	1	210	658	1406	3.13	2.14	1	0	0	1	14	16	18	6	18	31	73	12.86	241	283	0.85	0.74	0.13
MH	1	603	1832	4412	3.04	2.41	3	0	0	1	9	13	32	28	25	52	137	7.94	655	740	0.89	0.81	0.08
MI	9	47	136	311	2.89	2.29	3	1	0	1	1	6	3	2	5	9	19	16.07	56	66	0.85	0.71	0.16
MM	1	140	418	886	2.99	2.12	0	0	0	0	4	4	11	8	6	12	37	7.89	152	177	0.86	0.79	0.08
MR	1	355	1057	2378	2.98	2.25	34	5	0	17	16	72	23	17	14	84	138	19.13	439	493	0.89	0.72	0.19
MS	1	38	104	182	2.74	1.75	0	0	0	0	0	0	2	0	1	9	12	19.15	47	50	0.94	0.76	0.19
PM	1	429	1334	3051	3.11	2.29	10	12	1	14	10	47	28	16	24	28	96	6.13	457	525	0.87	0.82	0.06
PP	9	214	584	1494	2.73	2.56	12	8	0	31	4	55	9	14	6	15	44	6.55	229	258	0.89	0.83	0.07
PZ	1	1210	3595	7313	2.97	2.03	56	29	9	66	25	185	111	35	92	173	411	12.51	1383	1621	0.85	0.75	0.13
RD	1	94	329	646	3.50	1.96	0	0	0	1	1	2	5	2	1	4	12	4.08	98	106	0.92	0.89	0.04
RF	1	406	1194	2530	2.94	2.12	22	11	0	12	8	53	22	13	25	49	109	10.77	455	515	0.88	0.79	0.11
RH	1	510	1610	3421	3.16	2.12	8	7	2	16	8	41	30	13	33	74	150	12.67	584	660	0.88	0.77	0.13
RK	1	35	98	206	2.80	2.10	0	0	0	0	0	0	3	0	13	3	19	7.89	38	54	0.70	0.65	0.08

Exhibit 5.5.2
Interviewer Performance Report for December 11, 1991 (cont'd...)

ID	Acc	Comp Inter	Total Pers	Total Trips	Ave Pers per Hsehold	Trip Rate per Person	No. Call Back	No. Ans Mach	No. Busy	No. No Ans	For	Total Incom	Bus Line	8 Att	Out of Ser	Ref	Tot Unsucc	% Unsucc of Total	Total Cont	Sam Used	Cont Rate	Comp Rate	Refusal Rate
RM	1	229	642	1263	2.80	1.97	26	28	3	44	8	109	20	17	20	57	114	19.93	286	343	0.83	0.67	0.20
RR	1	356	1000	2104	2.81	2.10	13	11	0	23	10	57	33	21	11	30	95	7.77	386	451	0.86	0.79	0.08
SA	1	692	2119	4413	3.06	2.08	11	4	1	16	27	59	60	24	36	71	191	9.31	763	883	0.86	0.78	0.09
SC	1	4	10	9	2.50	0.90	0	0	0	0	0	0	0	0	0	0	0	0.00	4	4	1.00	1.00	0.00
SF	1	624	1831	3938	2.93	2.15	13	5	1	18	13	50	10	30	41	18	99	2.80	642	723	0.89	0.86	0.03
SS	1	301	866	1805	2.88	2.08	2	0	0	1	17	20	22	17	26	24	89	7.38	325	390	0.83	0.77	0.07
TE	1	785	2398	5263	3.05	2.19	37	10	3	48	20	118	51	38	46	120	255	13.26	905	1040	0.87	0.75	0.13
TH	1	546	1672	3577	3.06	2.14	11	9	3	15	17	55	35	20	43	58	156	9.60	604	702	0.86	0.78	0.10
TL	1	11	27	58	2.45	2.15	0	0	0	0	2	2	0	0	1	0	1	0.00	11	12	0.92	0.92	0.00
VV	1	27	95	202	3.52	2.13	1	0	0	0	0	1	2	1	0	9	12	25.00	36	39	0.92	0.69	0.25
WM	1	520	1508	3321	2.90	2.20	30	22	2	28	8	90	26	22	39	87	174	14.33	607	694	0.87	0.75	0.14
TOTALS		23561	69860	151179	2.97	2.16	845	559	62	1220	695	3382	1658	974	1410	2902	6944	10.97	26463	30505	0.87	0.77	0.10

ID = Initials of interviewer/superivsor used to access the DDE software
Acc = Type of access mode to the DDE software
1 = Interviewer
9 = Supervisor
Comp Int = Total completed interviews
Total Pers = Total number of persons collected
Total Trips = Total number of trips colected
Ave Pers per Hsehld = Average number of persons per household
Trip Rate per Person = Trip rate per person
No. Call Backs = Total number of call backs
No. Ans Mach = Total number of answering machines contacted
No. Busy = Total number of busy contacts
No. No Ans = Total number of no answer
For = Total number of foreign language interviews
Total Incom = Total number of incomplete interviews
Bus Line = Total number of contacted business lines
8 Att = Total number of households contacted 8 or >8 times
Out of ser = Total number of lines out of service
Ref = Total number of refused interviews
Total Unsucc = Total number of unsuccessful contacts
% Unsucc of Total = Percent of unsuccessful contacts of total households
Total Cont = Total households that were contacted
Sam Used = Total number of sample used
Con Rate = Contact rate of interviewer
Comp Rate = Completion rate of interviewer
Refusal Rate = Refusal rate for interviewer

Exhibit 5.5.3 - Progress Report for December 11, 1991

MCA	SCA	Total Houses Contacted	Target Sample	Completed Interviews	Incomplete Interviews	Active Sample	Total Rejects	Required Sample Remaining	Percent Completion	Tot Pers in Completed Hseholds	Tot Vehs in Completed Hseholds	Tot Trips in Completed Hseholds	Average Hsehold Size	Trip Rate per Hsehld	Trip Rate per Person
1	1	86	79	63	4	4	19	16	79.75	177	103	393	2.81	6.24	2.22
1	2	113	98	82	6	3	25	16	83.67	284	160	725	3.46	8.84	2.55
1	3	72	64	54	3	2	15	10	84.38	170	94	372	3.15	6.89	2.19
1	4	295	256	216	15	17	64	40	84.38	548	323	1307	2.54	6.05	2.39
1	11	190	166	135	9	7	46	31	81.33	475	266	1092	3.52	8.09	2.30
1	12	112	103	82	7	9	23	21	79.61	279	158	611	3.40	7.45	2.19
1	13	100	85	79	5	4	16	6	92.94	199	115	456	2.52	5.77	2.29
1	14	109	114	88	6	4	15	26	77.19	318	161	652	3.61	7.41	2.05
1	15	106	94	81	2	3	23	13	86.17	241	162	436	2.98	5.38	1.81
1	16	131	116	105	4	4	23	11	90.52	366	186	800	3.49	7.62	2.19
1	17	131	124	102	3	5	26	22	82.26	336	178	668	3.29	6.55	1.99
1	18	117	108	92	5	5	20	16	85.19	284	168	653	3.09	7.10	2.30
1	19	103	98	78	7	9	18	20	79.59	211	111	411	2.71	5.27	1.95
1	20	153	136	110	9	10	34	26	80.88	267	143	570	2.43	5.18	2.13
1	21	83	70	59	7	5	17	11	84.29	183	102	448	3.10	7.59	2.45
1	22	110	108	93	1	3	16	15	86.11	290	159	703	3.12	7.56	2.42
1	23	223	194	159	11	10	53	35	81.96	473	254	1100	2.97	6.92	2.33
1	24	137	126	110	6	8	21	16	87.30	407	207	901	3.70	8.19	2.21
1	25	104	84	81	3	3	20	3	96.43	255	174	593	3.15	7.32	2.33

Exhibit 5.5.3
Progress Report for December 11, 1991 (cont'd...)

MCA	SCA	Total Houses Contacted	Target Sample	Completed Interviews	Incomplete Interviews	Active Sample	Total Rejects	Required Sample Remaining	Percent Completion	Tot Pers in Completed Hseholds	Tot Vehs in Completed Hseholds	Tot Trips in Completed Hseholds	Average Hsehold Size	Trip Rate per Hsehld	Trip Rate per Person
1	26	88	78	68	2	2	18	10	87.18	208	113	476	3.06	7.00	2.29
1	27	73	78	65	2	1	6	13	83.33	208	108	462	3.20	7.11	2.22
1	28	159	153	130	9	8	20	23	84.97	420	256	933	3.23	7.18	2.22
1	29	191	175	152	12	12	27	23	86.86	467	308	1079	3.07	7.10	2.31
1	30	171	138	129	9	10	33	9	93.48	349	198	766	2.71	5.94	2.19
1	31	130	116	98	9	7	23	18	84.48	255	156	527	2.60	5.38	2.07
1	32	176	162	139	16	18	21	23	85.80	401	253	805	2.88	5.79	2.01
1	33	142	115	100	5	5	37	15	86.96	297	211	614	2.97	6.14	2.07
1	34	248	230	194	16	19	38	36	84.35	593	397	1249	3.06	6.44	2.11
1	35	243	198	160	23	22	60	38	80.81	451	321	859	2.82	5.37	1.90
1	36	222	190	158	15	21	49	32	83.16	491	315	1007	3.11	6.37	2.05
1	37	132	120	103	7	10	20	17	85.83	262	156	590	2.54	5.73	2.25
1	41	115	96	76	12	12	27	20	79.17	233	140	427	3.07	5.62	1.83
1	42	80	76	65	3	5	12	11	85.53	202	117	454	3.11	6.98	2.25
1	51	151	140	114	10	22	27	26	81.43	387	223	899	3.39	7.89	2.32
1	52	122	110	93	12	15	18	17	84.55	282	160	705	3.03	7.58	2.50
1	53	347	337	259	24	57	64	78	76.85	759	453	1897	2.93	7.32	2.50
1	54	266	263	203	16	45	47	60	77.19	597	389	1430	2.94	7.04	2.40
Totals		5531	4998	4175	315	406	1041	823	84.21	12625	7498	28070	3.05	6.74	2.21

5.5.5 Feedback from the Coding Process

Completed interviews were run through a batch process and then added to the coding database after the review and editing process. The review process usually took one day which meant most completed interviews were added to the coding database two days after the conduct of the actual interview and could be checked and geocoded by the coding staff within three days. If the geographic information collected by interviewers proved to be insufficient or ambiguous, the coders would identify the problem on a printout of the interview and pass it back to one of the interview supervisors to call back the household for clarification. This quick processing enabled respondents to clarify the problems while the interview was still fresh in the mind of the respondent.

5.6.0 Answering Machines

Prior to the conduct of the survey, it was anticipated that the high proportion of households that now utilize answering machines would be a major problem. The Direct Data Entry software incorporates the script for a message to be left on any answering machines which were encountered. The script identifies the survey and requests that a member of the household call the survey office during the day. Both local calling and 1-800 numbers were given. The Direct Data Entry would also schedule the next attempted call to the household three days plus one hour to allow time for someone to respond to the message.

The original plan was when a person called back, in response to an answering machine message, a supervisor would ask the respondent for their home phone number and would locate the household on the sample control computer to conduct the interview immediately. This was found to be impractical due to the number of calls and the almost continuous use to which the sample control computer was being put. The plan was modified so that when a call came in, the person answering it would write down both the home phone number and the number the person was calling from (often an office number) so that a supervisor could call them back to do the interview. The sample control computer was then used to identify which interviewer's diskette the household was on. A supervisor was then able to call up the household on any of the interview computers and return the call in order to complete their interview. Calls were returned within a few minutes except when there was a problem getting access to the sample control computer.

5.7.0 Strikes

The most serious problems which arose during the actual conduct of the survey were a direct result of two strikes that occurred right at the start of the survey, the first by Canada Post workers (August 26th to September 5th) and the second by employees of the Toronto Transit Commission (September 12th to September 19th). The postal strike occurred immediately following the mailing of the first batch of advance letters. The 1986 TTS, the pretests and the pilot survey for the 1991 TTS had demonstrated the importance of the advance letter in obtaining a low refusal rate and minimising the amount of time interviewers needed to explain the purpose of the survey. A combination of private courier and priority post services were used for the second and third mailings. The postal service had returned to normal for subsequent mailings.

The Priority Post service, provided by Canada Post, but purportedly not affected by the strike, was used for letters outside Metro Toronto at a cost of $1.70 per letter. The use of Priority Post resulted in some negative feedback from recipients who questioned the need and justification for using a premium service for the conduct of a survey. Later, it was discovered using Priority Post was against Provincial Government Policy and it might have been construed as strike breaking.

The private courier was used to deliver letters within Metro Toronto at a cost of $1.60 each. No complaints were received with respect to these letters probably because there was no stamp or other indication on the envelope to show how they were delivered.

The transit strike was a more serious concern because of its direct effect on travel behaviour and the potential distortion of any data collected during the strike. No interviewing was done for Metropolitan Toronto or the Regions of York and Peel during the strike or in the week immediately following it. Training of new interviewers had been temporarily suspended in anticipation of the strike and was not continued until the strike was resolved. Work attendance was also adversely affected as most interviewers were dependent on public transportation. Interviewers were encouraged to carpool and the survey paid for parking and the costs of taking taxis home when no other transportation was available. The reduced numbers did make it relatively easy to restrict the interviewing to the Regions of Hamilton-Wentworth and Halton with a few in Durham. This was done by doubling the number of interview stations assigned to MCA 6 (Hamilton-Wentworth and Halton) from 6 to 12 during the strike and subsequently reducing them following the contract settlements.

Both strikes caused problems for the Publicity Team since the media was preoccupied with stories covering each of the strikes. The combined effect of the two strikes also created sample control problems. The first mailing by Canada Post was increased in size because of the pending postal strike, and was biased in favour of Metro Toronto in anticipation that if there was a Toronto transit strike it would not be until later in the survey. The fact that the strike was held before the survey coupled with the reduced number of interviewers in the early stages of the survey meant that there was a substantial surplus of mailings sent out to Metro residents in the first few weeks. As a result, 1900 households had to be deleted from the active sample because they could not be contacted within a reasonable time of the letters being sent out (4 weeks). The additional interview stations assigned to Hamilton-Wentworth and Halton created tracking problems in monitoring the number of incomplete interviews, the number of households not yet called on each interviewers' diskette and the scheduling of call backs. While these problems caused difficulties for survey staff, it is believed that the problems were resolved without any adverse effect on the quality of the final data.

In addition to the sample control problems, the strikes put the survey significantly behind schedule. In order to make up for the lost time, it was necessary to institute Saturday interviewing for the remainder of the survey. Some Saturday interviews were conducted for Friday trips and some for Thursday trips to avoid over representation of a single week day. The Saturday interviews were conducted between 12 noon and 5 p.m.

5.8.0 Software Changes

A number of problems arose during the conduct of the survey which necessitated changes to the software. Most significant was the inefficient performance of the sample control software. The original design required that the sample diskettes used by each interviewer be updated sequentially

every day. The time required to update each disk was quick enough in the pretests and pilots, but escalated rapidly as the size of the database increased to the point where it was taking until 1.30 a.m. every day by the 3rd week of the survey. Some of the reports were also taking up to 1 hour to generate. Changes were made to the sample control software to enable some of the processing of the sample information to be done in batch mode overnight and to improve the efficiency of report production. These changes proved adequate for the duration of the survey, but by the time the survey finished the batch process was taking up to 8 hours to run. The batch process had to be complete before interview diskettes could be updated for the next interviewing sessions and performance reports printed or completed interview information passed on for further processing. Throughout the survey, there were no delays to the interviewing, but on several occasions when the batch process failed, it required two to three days for the rest of the processing to get back on schedule.

Minor changes were made to both the direct data entry and sample control software involving the manner in which the trip day was recorded, the tracking of interviewer ID codes when multiple calls were made to complete an interview and the recording and scheduling of foreign language call backs.

6.0 Completion Statistics

Exhibit 6.0. gives a summary of the completion statistics and compares the overall refusal and completion rates with corresponding data from the 1986 survey. Most significant was the change in the refusal rate, down from 25.9% to 11.3%. The number of completions was at least 95% of the target in all but 4 of the 188 sample control areas (SCAs). Those 4 were:

SCA # 311 in Downtown Toronto (90%)
SCA # 238 in Scarborough (90%)
SCA # 551 in Etobicoke (92%) and,
SCA # 652 in Ancaster (93%).

All four were designated as high growth areas and fell short of the target because of insufficient sample due in part to lower than average completion rates. The target for the three in Metropolitan Toronto could have been achieved if it were not for the 1,900 households in the sample which were discarded following the transit strike.

A total of 146 households were discarded in the coding and review process to produce a final database of 24,507 households. The fact the review process involved several stages accounts for the minor differences in the totals reported at different stages.

The number of interviews completed each day is shown in Exhibit 6.1.0 and the cumulative total in Exhibit 6.2.0. Average completion rates per paid hour of interview time are shown in Exhibit 6.3.0. The relatively high number of completions on the first day was a result of requiring all interviewers to work the first day. Due to the transit strike and the temporary suspension of training activities, no new interviewers were added to the active roster until the fourth week of the survey. The drop in the number of daily completions towards the end of that week can be attributed to a flu epidemic. The trend from the fourth week onwards should be representative of what one would have expected to see from the start of the survey if it had not been for the transit strike. Without the strike, it could have been possible to complete an additional 3,000 to 4,000 interviews within the available time frame for the survey.

Exhibit 6.0
Summary Completion Statistics

	Number of Households		
Completed Interviews		24,653	(1)
Discarded Interviews (in review process)	113		
Discarded Interviews (after geocoding)	33		
Final Database		24,507	
Refusals	3,160		(2)
Eligible contacts (1)+(2)		27,863	(3)
Not eligible (Business line)	1,909		(4)
Line not in service	1,504		(5)
No contact (8 attempts)	2,115		(6)
Incomplete (less than 8 attempts)	776		(7)
Call back	710		
Answering machine	38		
No answer	28		
Sample used (3)+(4)+(5)+(6)+(7)		34,167	(8)
Not called (End of survey)	800		(9)
Not called (Stale due to strike)	1,961		(10)
Letters mailed (8)+(9)+(10)		36,928	(11)
Unused sample	20,671		(12)
Available sample (11)+(12)		57,599	(13)
Refusal Rate (2)/(3) [1986]		11.3%	[25.9]
Completion Rate (1)/(8) [1986]		72.2%	[60.1]

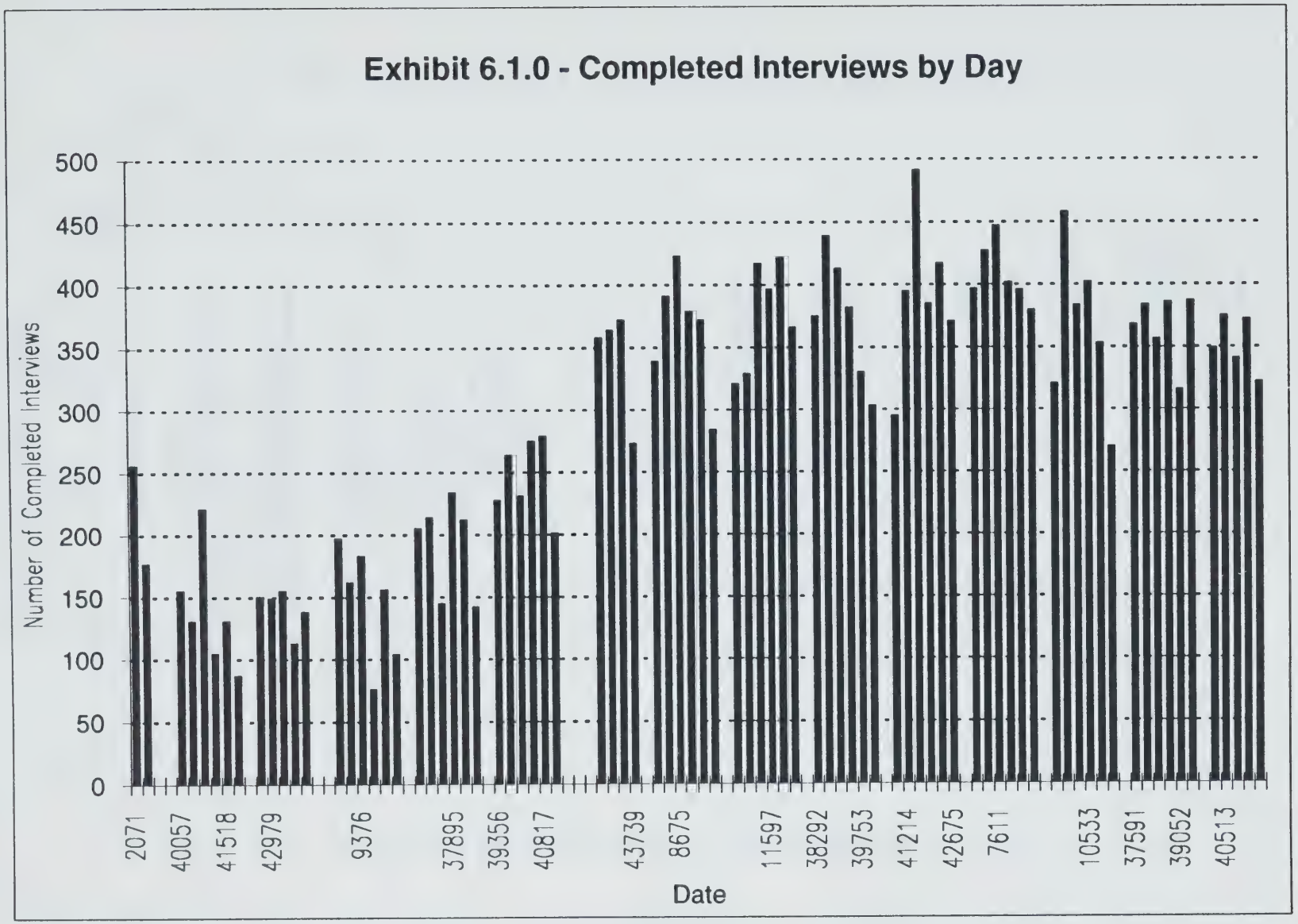


Exhibit 6.1.0 - Completed Interviews by Day
Number of Completed Interviews
500
450
400
350
300
250
200
150
100
50
0
2071
40057
41518
42979
9376
37895
39356
40817
43739
8675
11597
38292
39753
41214
42675
7611
10533
37591
39052
40513
Date

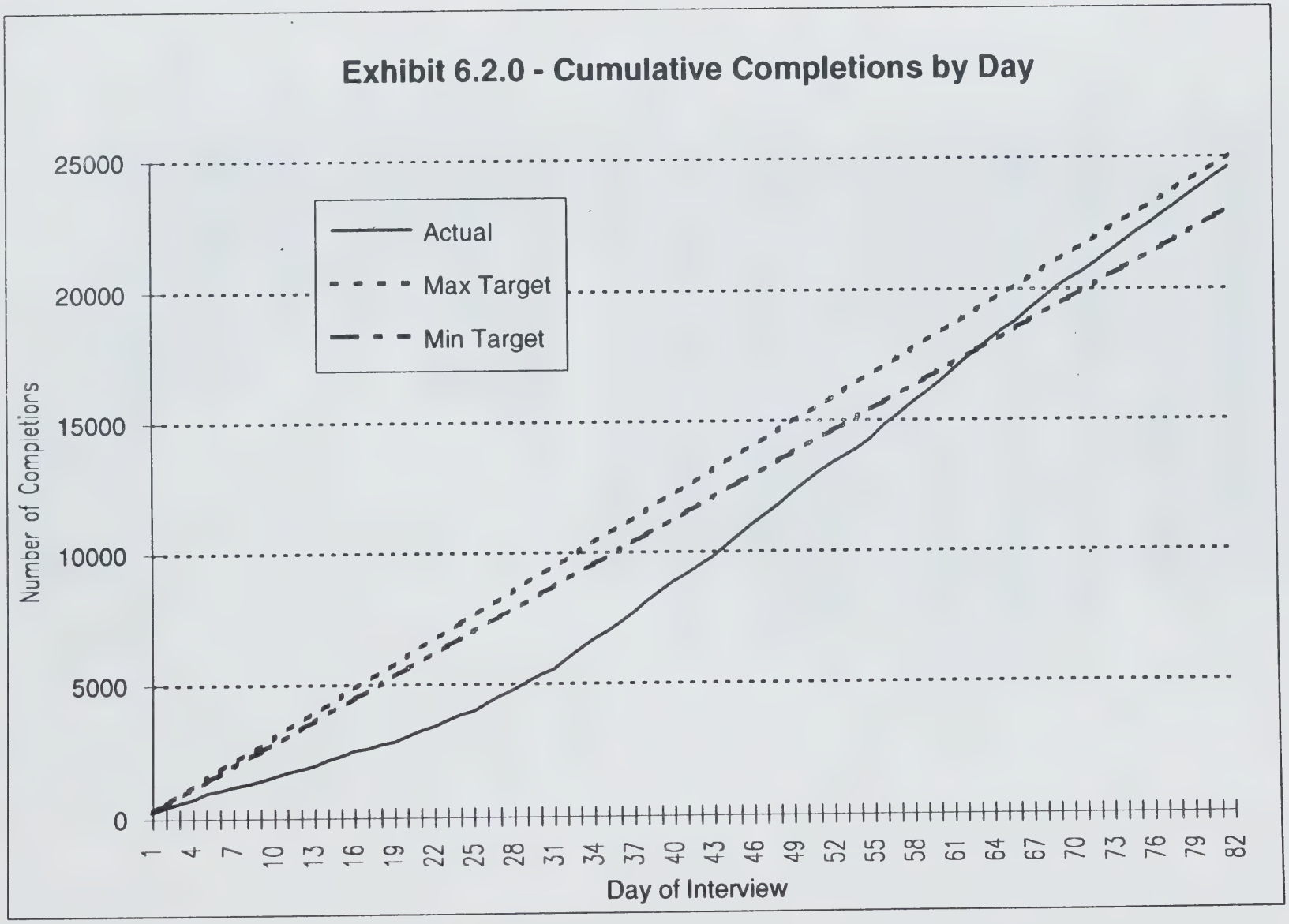


Exhibit 6.2.0 - Cumulative Completions by Day
25000
20000
15000
10000
5000
0
Number of Completions
Actual
Max Target
Min Target
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
67
70
73
76
79
82
Day of Interview

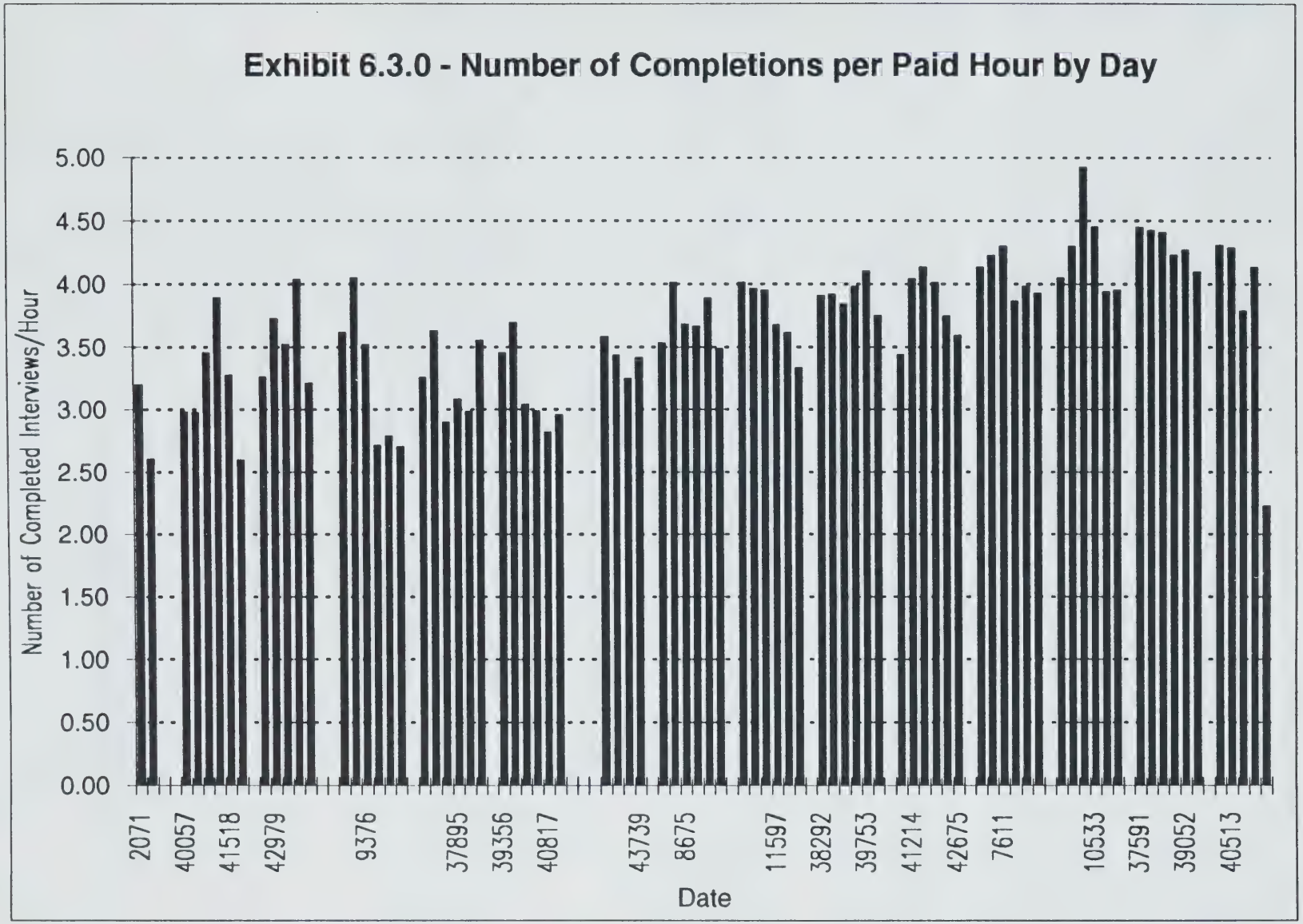


Exhibit 6.3.0 - Number of Completions per Paid Hour by Day
Number of Completed Interviews/Hour
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2071
40057
41518
42979
9376
37895
39356
40817
43739
8675
11597
38292
39753
41214
42675
7611
10533
37591
39052
40513
Date

Interviewer productivity is summarized by week in Exhibit 6.4.0. The number of completed interviews per paid hour of interview time started at 3.0 and increased to 3.5 over the first two weeks while no new interviewers were being trained. As a result of less experienced interviewers being added to the roster, it dropped to 3.2 for the next three weeks, then increased steadily to an average of about 4.0 for the last six weeks of the survey. The drop in rate during the last week of the survey was due to a concerted effort to complete outstanding call backs. The interviewers received three hours pay for two hours work on the final night of the survey. The better interviewers consistently recorded 4.5 to 5 completions per hour. The highest rate recorded by an interviewer was over eight completions per hour on two consecutive evenings. These rates are considerably higher than the maximum rates which were achieved in 1986 using paper and pencil. Monitoring procedures ensured these high rates were not achieved at the expense of data quality. Interviewers with the highest completion rates also tended to have the fewest problems requiring call backs and their trip rates per person were consistently uniform at, or slightly above, the overall average.

High productivity achieved by the more experienced interviewers was more than enough to compensate for the increased rates of pay and incentive bonuses. The direct interviewer wage cost per completion averaged $5.50 for the first six weeks of the survey, dropped to $4 in the 8th week and remained the same for the rest of the survey except for the last week. There was no significant variation in the average trip rate per person throughout the survey.

A comparison of completion and trip rates is given in Exhibit 6.5.0. Completion rates were highest on Tuesday nights and significantly below average on Friday nights. Trip rates recorded on Monday nights (Friday trips) were slightly above average and below average on Tuesdays (Monday trips). Saturday interviewing was split between Thursday and Friday trips which means that these two days are over represented in the final database. The marginal differences in trip rates between days of the week is not expected to create a significant bias.

7.0 Coding

The task of coding the 1991 survey was simpler than the 1986 survey due to the use of the Direct Data Entry (DDE) software. The DDE software was designed to code survey data as the interview proceeded. This included the numbering of persons and trips, assigning codes for trip purpose and mode, coding and validating transit routes and transfer points, etc. The remaining task of coding the survey data was limited to error checking and the geocoding of location information. There were five types of location information which required geocoding:

1) A household's address

2) A person's usual place of work

3) A person's usual place of school

4) First origin of the day and,

5) Every subsequent trip destination

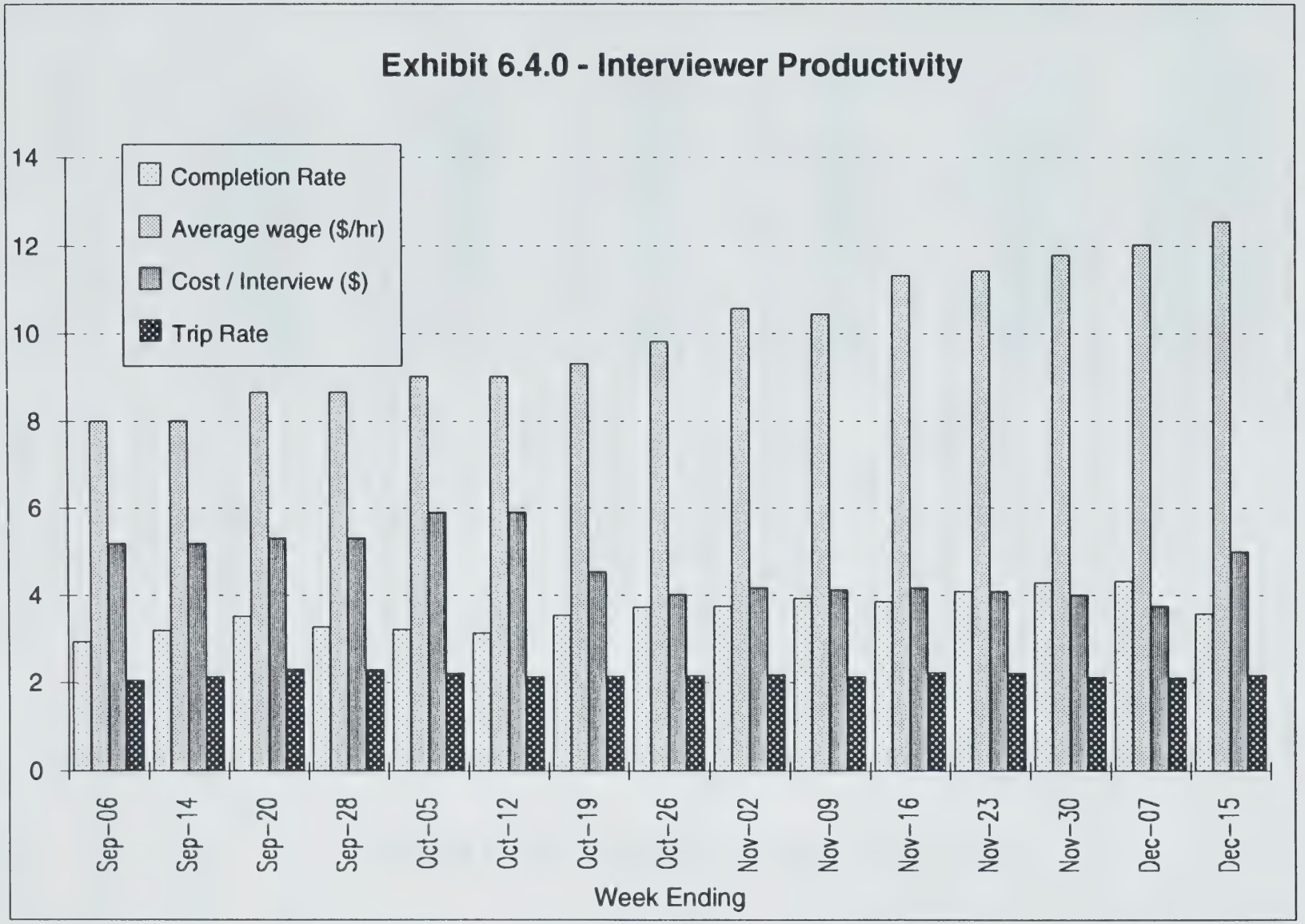


Exhibit 6.4.0 - Interviewer Productivity
Completion Rate
Average wage ($/hr)
Cost / Interview ($)
Trip Rate
14
12
10
8
6
4
2
0
Sep-06
Sep-14
Sep-20
Sep-28
Oct-05
Oct-12
Oct-19
Oct-26
Nov-02
Nov-09
Nov-16
Nov-23
Nov-30
Dec-07
Dec-15
Week Ending

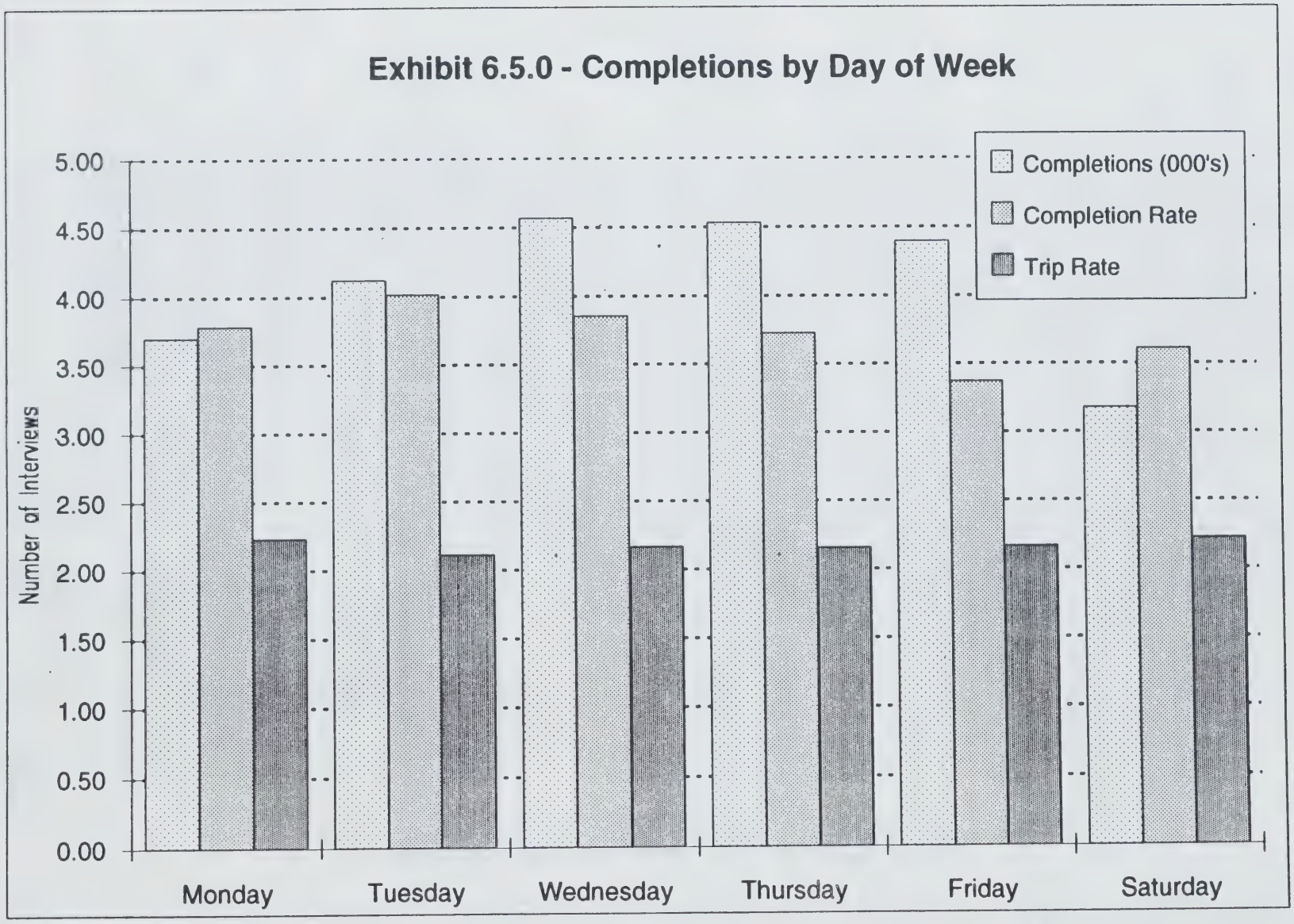


Exhibit 6.5.0 - Completions by Day of Week
Completions (000's)
Completion Rate
Trip Rate
Number of Interviews
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

7.1.0 Coding Tasks

Completed interviews were divided into two files on the geocoding computer. The first file, referred to as the Review File, contained interviews which were pending for editing or call back (i.e., those records with error flags). After corrections or confirmations were made, those records in the Review File were transferred to the second file, referred to as the Coding File. Transfers were conducted on a daily basis. The Coding File contained error-free interviews which were ready for geocoding and interviews which had already been geocoded.

Geocoding on the Coding File was performed in two steps. Each day a batch geocoding program was run on records with a "not-coded" flag for automatic look-ups. Records which could not be geocoded were flagged with error codes. A manual geocoding team then worked through those records which failed the batch process. If a record required additional information, the manual coder had the option of writing a brief call back message and sending the entire interview on hard copy back to the interviewing team for call backs. Approximately 1,650 or 7% of the surveyed households required call backs. Due to the potential deficiency in the AMF (i.e., the lack of updates on street names and address ranges in areas which were rural, industrial or had experienced extensive development), it was anticipated that a large number of records might have to be geocoded using MapInfo. However, only some 500 records or 0.75% of the manual coding work was actually performed in MapInfo.

7.2.0 Quality Control

Geocoding began two days after interviewing started on September 7, 1991 and officially finished at the end of January 1992. Geocoding error checks were performed during the last two weeks of January 1992 using the following conditions.

1. Household with wrong number of persons.
2. Person with wrong number of trips.
3. Duplicate household, person or trip number.
4. Trip recorded out of start time sequence.
5. Transit trip without transit route information.
6. Household with geocoded coordinates outside of the survey area.
7. Invalid transfer points (i.e., invalid subway or GO Rail station names.)
8. Invalid walk trip (i.e., trip purpose not equal work, school or home.)
9. Total trip distance of more than 200 km.
10. Total trip distance of less than 100 metres.
11 Walk distance of more than 5 km.
12. Cycle distance of more than 30 km.
13. Walk access or egress distance from subway stations of more than 3 km.
14. Total subway access or egress distance of more than 20 km.
15. Home to home, work to work, or school to school trips of zero length.
16. Any location coordinates which could not be assigned to a traffic zone.

Approximately 2% of the total survey records met one or more of the above conditions and were checked individually. An error rate of less than 3% was obtained.

Exhibit 7.3.0 - Geocoding Statistics

TOTAL HOUSEHOLDS - 24540

BATCH TOTAL		% TOTAL	MANUAL TOTAL		% TOTAL	NOT CODED TOTAL	
Postal Code	4736	28.15	Postal Code	0	0.00	Map Info	0
Address	10888	64.72	Address	6809	88.35	Call Back	0
Intersection	1	0.01	Intersection	129	1.67	Don't Know	11
Monument	1	0.01	Monument	7	0.09	No Attempt	0
Place Name	1196	7.11	Place Name	762	9.89	Refuse	0
Batch Total	**16822**		**Manual Total**	**7707**		**Not Coded Total**	**11**

TOTAL PERSONS - 72676

Not Employed: 35948 **Work Total: 36728**

BATCH TOTAL		% TOTAL	MANUAL TOTAL		% TOTAL	NOT CODED TOTAL	
Refuse/Don't Know	82	0.49	Address	6465	32.31	Map Info	0
Home	1962	11.77	Intersection	9600	47.98	Call Back	0
Address	4252	25.50	Monument	3586	17.92	Don't Know	47
Intersection	8122	48.72	Place Name	358	1.79	No Attempt	0
Monument	1111	6.66				Refuse	0
Place Name	1143	6.86					
Batch Total	**16672**		**Manual Total**	**20009**		**Not Coded Total**	**47**

Not a Student: 59952 **School Total: 12724**

BATCH TOTAL		% TOTAL	MANUAL TOTAL		% TOTAL	NOT CODED TOTAL	
Refuse/Don't Know	27	0.30	Address	508	14.17	Map Info	0
Home	0	0.00	Intersection	74	2.06	Call Back	0
Address	7	0.08	Monument	2775	77.38	Don't Know	4
Intersection	34	0.37	Place Name	229	6.39	No Attempt	0
Monument	8252	90.34				Refuse	0
Place Name	814	8.91					
Batch Total	**9134**		**Manual Total**	**3586**		**Not Coded Total**	**4**

No Trips: 22547 **Origin Total: 50129**

BATCH TOTAL		% TOTAL	MANUAL TOTAL		% TOTAL	NOT CODED TOTAL	
Refuse/Don't Know	19	0.04	Address	66	16.84	Map Info	0
Home	49203	98.93	Intersection	69	17.60	Call Back	0
Work	276	0.55	Monument	108	27.55	Don't Know	0
School	17	0.03	Place Name	149	38.01	No Attempt	0
Address	4	0.01				Refuse	0
Intersection	54	0.11					
Monument	53	0.11					
Place Name	111	0.22					
Batch Total	**49737**		**Manual Total**	**392**		**Not Coded Total**	**0**

TRIP TOTAL: 158019

BATCH TOTAL		% TOTAL	MANUAL TOTAL		% TOTAL	NOT CODED TOTAL	
Refuse/Don't Know	58	0.05	Address	6105	18.07	Map Info	0
Home	66311	53.40	Intersection	15993	47.33	Call Back	0
Work	28942	23.31	Monument	9617	28.46	Don't Know	44
School	9840	7.92	Place Name	2077	6.15	No Attempt	0
Address	855	0.69				Refuse	0
Intersection	11521	9.28					
Monument	4123	3.32					
Place Name	2533	2.04					
Batch Total	**124183**		**Manual Total**	**33792**		**Not Coded Total**	**44**

7.3.0 Statistics

The coding team started with four coders and increased to six coders by the middle of the survey. Each coder worked approximately seven hours per day and was designated to work on households in a particular MCA in order to ensure familiarization with streets, transit routes etc. The average number of locations checked and geocoded per hour by a coder was between 35 and 40.

A location was geocoded by one of three methods: (1) cross referenced to another location field (i.e., trips to home, usual place of work or usual place of school), (2) batch processing or (3) manual geocoding. The cross-referencing feature processed more than half (55%) of the location data and was mainly related to home-based trips. Of the remaining locations which required geocoding, the batch geocoding process had a success rate of 48%. This exceptional accomplishment was a result of interviewer training and the use of on-line look-up routines (e.g., street and school names) in the DDE software.

Exhibit 7.3.0 is a detailed breakdown of the geocoding tasks by location types. The number of records in the final TTS database is less than that in Exhibit 7.3.0. because a number of invalid household samples were included in the exhibit. Table 7.3.0 gives a summary on Exhibit 7.3.0 by excluding records which could not be geocoded

Table 7.3.0
Geocoded Trips by Location Types (Excluding records not geocoded)

	Batch Geocode		Manual Geocode		Cross Reference		Total	
Address	16,006	26.7%	19,953	30.5%			35,959	12.7%
Monument	13,540	22.6%	16,093	24.6%			29,633	10.5%
Intersection	19,732	32.9%	25,865	39.5%			45,597	16.3%
Place Name	5,797	9.7%	3,575	5.4%			9,372	3.3%
Postal Code	4,736	7.9%					4,736	1.7%
X-reference					156,551	100.0%	156,551	55.5%
Total	59,811	21.2%	65,486	23.3%	156,551	55.5%	281,848	100.0%

8.0 Survey Budget and Costs

The budget for the survey was originally set at $800,000 based on a target of 20,000 completed household interviews with the assumption that Hamilton-Wentworth would not be part of the survey area. The total figure was subsequently increased to $860,000 for 23,000 completed interviews when it became known that Hamilton-Wentworth would be participating in the survey. A further upward revision of $877,000 was made to allow for payment of the Goods and Services Tax (GST) introduced in January 1991. Budget estimates were based on a projected marginal cost of $15

per interview with the balance being fixed costs associated with development and project management. The cost of coding was substantially less than originally estimated so that, with other savings, it is expected that the survey will be completed for $834,000, $43,000 below budget (including 1500 extra interviews). The direct marginal cost per interview is estimated to have been $12.69.

8.1.0 University Overhead and Taxes

For the survey project, the agreed overhead charged by the University of Toronto is 40% of staffing costs and 2% on other expenditures. These overhead charges are used to cover the cost of providing the Data Management Group Office facilities, general supplies and secretarial services. The survey qualifies as a University Research project which means that most equipment purchases were exempt from Provincial Sales Tax. The University also qualifies for a refund of 2/3 of the 7% GST paid on the purchase of goods and services. University staff costs are exempt from the GST. The net amount of GST is included, where applicable, in the following cost figures.

8.2.0 Payroll Administration

The interview and coding staff were hired and paid by the Survey General Manager, who then invoiced the Data Management Group for the net amount of the payroll, including compulsory fringe benefits. The General Manager received an additional fee, equal to 2.6% of the net payroll, to cover the cost of payroll administration and interim financing.

8.3.0 Cost Summary

Total survey costs have been broken down into three components for presentation in this report. Details of the first two components are given in Exhibits 8.3.0a and 8.3.0b The totals are as follows:

	Total Cost
1. Development	$173,000
2. Conduct of the Survey	$481,000
3. Analysis and Reports	$180,000 (Projected)
Total	$834,000

Analysis and reports includes the projected costs for survey staffing from the beginning of March 1992 to the end of the year.

In addition to being the developer of the coding software and an assistant in the development of the Direct Data Entry software, Mr Jerry Ng, of the Data Management Group, was the Assistant Manager and the Coding Supervisor. His time was proportioned as follows:

Assistant Manager	182 days
Software Development	120 days
Coding Supervisor	98 days

Exhibit 8.3.0a
Development Costs

Software Development		
Direct Data Entry		$45,000
Sample Control		$12,000
Coding		$16,000
	Sub-total	$73,000
Pretests		
Pretest 1		$ 5,000
Pretest 2		$ 2,500
Sample		$ 3,000
	Sub-total	$10,500
Management		
Manager & Assistant		$50,000
DMG Support Staff		$ 7,500
University Overhead		$32,000
	Sub-total	$89,500
Total Development Costs		**$173,000**

Development costs include:

1. Software development
2. Design and pretesting of the survey questionnaire
3. Analysis of sampling options and production of sampling plan
4. Management and overhead costs up to the end of December 1990

Exhibit 8.3.0b
Conduct of the Survey Costs

Interviewing		
Interview Staff		$81,000
Supervisors		$32,000
Chief Supervisor		$38,000
Administration		$3,000
	Sub-total	$154,000
Coding		
Coding Staff		$26,000
Coding Supervisor		$23,000
Administration		$1,000
	Sub-total	$50,000
Equipment		
Computer Hardware & Software		$42,000
Telephone & Headset Rental		$13,000
Resale of Equipment		- $ 6,000
Sub-total		$49,000
Other Direct Expenses		
Pilot survey		$5,000
Printing		$4,000
Mailing		$17,000
Publicity		$4,000
Office Space & Furniture		$20,000
Sample		$12,000
Office Expenses & Supplies		$5,000
	Sub-total	$67,000
Management		
Manager & Assistant		$92,000
DMG Support Staff		$13,000
University Overhead		$56,000
	Sub-total	$161,000
Total cost for the conduct of the survey		**$481,000**

Equipment costs include:

1. Purchase of four computers retained by DMG for future analysis of the survey data. (An allowance of $6000 has been made for their residual value.)
2. Net cost of ten computers purchased and resold by the DMG
3. Rental of twenty computers supplied by the Department of Civil Engineering
4. Visual monitoring equipment
5. Purchase of one printer

Management staff costs are for the period from January 29, 1992 to February 29, 1992; the latter being the approximate date at which the survey data first became available for analysis.

8.4.0 Cost Comparison Between the 1986 and 1991 Surveys

Exhibit 8.4.0 gives a comparison of the 1991 survey costs with the costs of the 1986 survey as reported in the, "Design and Conduct of the Survey" report. Categorization of the costs was made as consistent as possible given the available information and the significantly different organization structure of the two surveys. An inflation factor of 27%, the rise in the consumer price index, has been used to adjust the 1986 costs to 1991 values.

Interviewing staff costs, at $6.29 per completed interview, were 33% higher than the inflated 1986 cost, a direct result of the significantly higher wage rates paid to interview staff. Equipment costs were also slightly higher reflecting the need for individual computers and the electronic monitoring equipment. The difference would have been higher if it were not for the savings in telephone costs realized through the use of the Government of Ontario's intercity network. The higher interview costs were more than offset by the elimination of separate data entry and by the improved efficiency of geocoding. There was a 70% reduction in the total coding cost of each household. Despite the use of couriers during the postal strike, the unit cost of printing and mailing letters was lower in 1991 than in 1986. The higher overall completion rate in 1991 (72% versus 60%), resulted in 17% fewer letters having to be mailed relative to the number of interviews completed. The 1986 letter costs likely include some preparation costs in the "Other" category for 1991. The total variable costs for the 1991 survey, at $12.69 per completed interview, are estimated to represent a 19% saving relative to the cost of the 1986 survey.

Equitable comparison of the fixed costs associated with the two surveys is more difficult. Approximately $130,000 has been included in the 1986 cost figures to reflect contributions made by the various agencies in addition to the survey budget. These contributions included:

1. Office space and phones for the Hamilton portion of the survey
2. Printing of letterhead
3. Staff assistance in training interviewers
4. Staff assistance in geocoding
5. Loan of computer equipment
6. Staff assistance in software development

No attempt was made to attach any monetary value to the time of senior staff from the agencies involved in the management and direction of the survey. No cost was included in the 1986 survey for the provision to the Survey General Manager of office space and secretarial services at the Ministry of Transportation or of the administrative costs incurred by Metropolitan Toronto in acting as the survey financier.

None of these hidden costs are applicable to the 1991 survey. The continuity provided by the Data Management Group significantly reduced the demands made on agency staff and eliminated some activities such as the preparation of terms of reference for the pilot survey, and the selection processes for the General Manager and a sub-contractor for the field work. In addition, at least $100,000 in development costs and $50,000 in survey costs should be added to the 1986 costs to provide a fair comparison with the 1991 figures.

Exhibit 8.4.0 - Cost Comparison Between 1986 and 1991 Surveys

Variable Costs (Directly related to the number of interviews conducted)

		1986 Cost	Adjusted for Inflation (+27%)	Adjusted 1986 Cost per Household	1991 Cost	1991 Cost per Household
Interviewing						
Interviewers & Supervisors		$230,000	$ 292,100	$ 4.73	$154,106	$ 6.29
Equipment & Supplies		$ 88,000	$ 111,760	$ 1.81	$ 53,929	$ 2.20
	Sub-Total	$318,000	$ 403,860	$ 6.54	$208,035	$ 8.49
Coding						
Data Entry		$ 70,000	$ 88,900	$ 1.44	n/a	n/a
Geocoding		$263,000	$ 334,010	$ 5.41	$ 49,649	$ 2.03
	Sub-Total	$333,000	$ 422,910	$ 6.85	$ 49,649	$ 2.03
Other Variable Costs						
Advance Letter		$ 60,000	$ 76,000	$ 1.23	$ 20,901	$ 0.85
Other Direct Costs		$ 53,000	$ 67,510	$ 1.09	$ 32,557	$ 1.33
	Sub-Total	$113,000	$ 143,510	$ 2.33	$ 53,458	$ 2.18
Total Variable Cost		**$764,000**	**$ 970,280**	**$15.72**	**$311,142**	**$12.69**
Per Person				**$ 5.67**		**$ 4.29**
Per Trip				**$ 2.62**		**$ 1.98**

$6000 has been deducted from the 1991 equipment costs representing the residual value of the equipment retained by the DMG for survey analysis.

Fixed Costs (Not directly related to the number of interviews conducted)

Pilot Survey & Pretests	$ 37,000	$ 46,990		$ 15,562	
Management	$ 88,000	$ 111,760		$160,922	
Other Costs	$ 65,000	$ 82,550		$ 3,942	
Total Fixed Costs	$190,000	$ 241,300	$ 3.91	$180,426	$ 7.36
Development Costs	$ 38,000	$ 48,260	$ 0.78	$172,948	$ 7.06
Total (Excluding analysis and reports)	**$992,000**	**$1,259,840**	**$20.42**	**$664,516**	**$27.11**
Per Person			**$ 7.37**		**$ 9.16**
Per Trip			**$ 3.40**		**$ 4.22**

The development and other fixed costs are higher per interview for the smaller survey and may have been even more had it not been without the experience gained from the 1986 survey. However, it should not be assumed that fixed costs associated with the conduct of the survey are completely independent from the size of the survey. The total cost of approximately $20 per household for the conduct of the survey, exclusive of development and analysis costs, is believed to be close to the minimum that can be achieved for any well designed and executed survey of this type regardless of its size.

9.0 Conclusions and Recommendations

9.1.0 Data Quality

An important factor in data quality is to ensure a high response rate to a survey in order to minimise potential bias based on who the respondents are. The total non-response rate of approximately 20% was half of what was expected based on the 1986 survey. The refusal rate (11%) was also half the rate experienced in 1986 (25%) despite the fact that researchers had warned survey staff to expect a significant increase. The low refusal rate and high response rate can be attributed to a number of factors rated in the following order of importance:

1. Quality of interviewer training
2. Text of the advance letter
3. Superior monitoring made possible by the direct data entry software
4. Sample stratification (Metro Toronto, where the refusal rate was highest and the response rate lowest, was sampled at a lower rate than other areas)

After correcting for differences in the questionnaire, sample frame and sample stratification, the overall trip rate per person was 8% higher than in the 1986 survey.

Early indications from the validation team are that the 1991 survey data is as accurate, and probably more so, than the 1986 data. This assessment is based on comparisons with cordon and ridership counts, trip length distributions by mode and the few problems encountered in geocoding the data. Some of this improvement may be attributed to the refinement of geocoding databases and procedures subsequent to the 1986 survey, but the single most important factor remains the quality and training of the interviewers. Good data collection is essential in order to produce a good quality database.

At the onset of the survey, answering machines were anticipated to be a problem, yet at the end of the survey, there were only 38 households designated as being incomplete with the last contact being a message left on an answering machine. Some of the 2,115 households (6.2% of attempted households) not contacted in 8 attempts would have included messages left on answering machines one or more times. No statistics were kept on the number of households that called in as a result of a message being left.

9.2.0 Selection and Training of Interviewers

A high degree of emphasis was put on the selection and training of good interviewers. It is anticipated that the benefits will be reflected in the quality and future analysis of the data. Key factors in success of the survey are believed to have been:

1. The payment of premium wage rates to attract good interviewers. Interviewers' wages usually represent 25% or less of the total cost of a survey.

   It is likely to be a false economy to seek cost savings in this area.

2. The use of incentive bonuses to retain experienced interviewers and to encourage them to work more shifts.

   These bonuses were probably less costly than training new interviewers.

3. A friendly, but competitive working environment.

4. Instruction in small groups followed by one on one practice sessions.

5. Supervisors who are knowledgeable about the transportation system and transportation data collection requirements.

6. The necessary skills for a good interviewer are a good telephone manner and touch typing. Previous market research experience is <u>not</u> a significant factor.

There is a limitation on the rate at which interviewers can be trained if they are to receive the same level of individual attention and supervision. The rate at which interviewers were trained in the four or five weeks following the transit strike, at 10 to 15 per week, was the maximum which could be handled by one team of supervisors. It is estimated that 30,000 interviews is the maximum which could have been completed in a three and half month period with the organization and training structure that was put in place for the 1991 survey. A larger survey would require an additional level of supervision which may decrease efficiency. The quality of interviewers is also likely to decline as one has to be less selective in order to recruit larger numbers.

Surveys of between 20,000 and 30,000 households, conducted over a 3 to 4 month period, are therefore, optimum in size for efficient management and good quality control. For larger surveys, consideration should be given to setting up independent working teams in different locations or an extension of the time period over which a survey is conducted.

9.3.0 Direct Data Entry

The primary objective of using a direct data entry system was to reduce the amount of time needed to process the survey information once the interviews had been conducted. This objective was met with the first release of the database occurring less than one month after the last call backs were made to verify information. The following objectives were also met:

1. The target for completed interviews was exceeded by 1,500 despite the disruptions caused by both postal and public transit strikes during the initial weeks.

2. It was demonstrated that well trained interviewers can achieve higher productivity (completed interviews per hour) than can be expected with a pencil and paper survey.

3. On-line data checks made possible by the direct data entry were instrumental in achieving a high quality, easily coded database. The checks were of particular value in the collection of transit route information.

4. The daily monitoring of interviewer performance and completion statistics, made possible by direct data entry, ensured a high degree of consistency and quality control in the data collected.

Staff involved in the project believe that significant benefits from the use of direct data entry and automated geocoding have been demonstrated to the point where their selection for future surveys should be a foregone conclusion given the necessary provisions outlined in the following:

1. The Direct Data Entry should be considered as part of a total automation package starting with the sample data in electronic format and finishing with an operational database.

2. Adequate lead time must be available for development and testing. The existing DDE software is specific to the 1991 TTS. New databases could be generated to perform an identical survey in another city, but any change at all to the survey content, or to definitions, may require extensive programming and retesting.

3. Support staff, with the necessary technical skills, must be on call at all times throughout the conduct of the survey. In a complex production system, problems have to be fixed immediately and cannot wait until the next day.

4. The performance of the sample control procedures and software were barely adequate for the size of survey which was conducted. Substantial redesign, possibly involving the networking of the interview and sample control computers, should be done before attempting another survey of a similar size or contemplating a larger one.

Minor deficiencies in the direct data entry software, which would be desirable to correct for any future survey, include:

1. Retention of a complete record of interviewer IDs who contacted a household at each attempt. The present version only records the ID of the first interviewer to collect trip data and the last one to call the household.

2. The interviewer ID field should be expanded to allow the use of complete names instead of just two initials.

3. Improving the tracking of non-English speaking respondents.

4. Ability to change the recorded trip day. In the present version, the date is recorded automatically the first time any trip information is entered for a specific household and cannot be changed even if the household is re-interviewed from the beginning.

9.4.0 Automated Geocoding

The benefits of automated geocoding have been amply demonstrated by the 1986 TTS and many other surveys conducted since 1986. The 1991 TTS realized significant productivity gains in the geocoding process. Coding costs, at about 30c per trip record, were 70% lower than in the 1986 survey. Lower than expected coding costs were the primary factor in enabling a $43,000 cut to be made in the total survey budget. Factors contributing to these gains include:

1. The on-line checking performed by the direct data entry software

2. The day after visual review of completed interviews

3. The efficiency of the new geocoding software created for the survey. This software can be refined for application to other surveys.

4. The ongoing refinement of the databases, such as the Area Master File and monument files, used in the geocoding process.

9.5.0 Survey Content

The design of the questionnaire, the definitions and the general flow of the interview was a success. Much of the credit can be attributed to the extensive pretesting and refinement which were done prior to the main survey. Changes made to the 1986 survey, particularly the place of work and school questions, proved to be effective and easy to implement. The elimination of trip data collection for persons under 11 years of age probably resulted in minor improvements in productivity and possibly eliminated concerns that some parents might have had about releasing information for young children. The collection of data for all bicycle trips did not add significantly to the amount of data collected. Data were collected for 1,083 bicycle trips, less than 0.7% of the total trips surveyed. The only item which caused a serious problem was the recording of the language in which the interview was conducted. The problems arose as a result of mistakes in both the survey design and in the software development which were never fully resolved. Identifying the language in which the interview was conducted provides little, or no information, on the ethnic background of a household. More useful information could be obtained by including a question, such as, "What language is spoken most often in your household?", as part of the household information which is collected.

9.6.0 Publicity

The key element in publicity is clearly the advance letter to each household. The contents and wording of the letter were highly effective in achieving the low refusal rate. The gain in interviewer productivity is sufficient to justify extraordinary measures, such as the use of couriers during the postal strike. Ensuring that the media is adequately informed is important to avoid any negative reactions, such as the one incident that occurred. Follow up press releases during the conduct of the survey might have prevented this from happening. The issuing of press releases is important, but holding press conferences as was done in 1986, and producing video clips are probably unnecessary expenses which add little to the success of the survey.

For future surveys, the Committee should insist that the media give reasonable coverage of the survey with follow-ups of papers, radio and television stations which do not comply. A following set of news announcements two months after the start or approximately halfway through the survey should be released.

9.7.0 Management Structure

The 1991 survey differed from the 1986 survey in that a management structure was put in place at the Data Management Group well in advance of the conduct of the main survey. The structure proved to be effective in achieving the following objectives:

1. Providing smooth transitions from the initial survey design though to the final analysis of the survey data collected.

2. Minimising the delay involved in having the survey data available for analysis. The first version of the database was available for preliminary analysis within two months of the survey being completed. The first general release after validation was in May 1992 less than 5 months after the survey. In 1986, it was more than 18 months before the survey data were available.

3. Greatly reducing the additional work load placed on agency staff during the conduct of the survey. Agency staff involvement was cut by at least 70% compared to the 1986 survey.

10.0 Modifications for Future Surveys

10.1.0 Computer Network

A high proportion of the data processing problems during the conduct of the survey were the result of human error in the handling, loading or copying of the interviewers' diskettes. Consideration should be given to having the interview computers connected to a central file server from which new sample can be drawn as needed. Such a system would have the following advantages:

1. Elimination of human error in the handling of diskettes

2. More efficient monitoring and production of reports

3. More versatile sample control and handling of advance mailings

The networking of computers would necessitate significant changes to both the direct data entry and sample control software.

10.2.0 Direct Data Entry Software

Changes identified as being required to the direct data entry software are minor in nature, but it is likely to be more efficient to perform a complete rewrite because of all the changes which have already been made since the original design. A rewrite will almost certainly be required to operate in a network environment. The cost of rewriting the software should be substantially less than the original development because of the excellent design framework which now exists.

11.0 1996 Survey

The 1986 and 1991 surveys have been highly effective in creating a centrally accessible and consistent database that can be used by all agencies involved in transportation planning. It is assumed that the members of TATPDCSC will wish to continue their collective data collection efforts in 1996. The five year interval is recommended since it coincides with the Canada census and as an appropriate interval of time over which to measure change. It is also recommended that 1996 be a new survey, as opposed to an update of the 1986 survey as was done in 1991. A target sample range of 4.5% to 5.0% throughout the survey area is recommended to provide origin-destination data of a similar quality to the 1986 data.

11.1.0 Survey Area

It is recommended that consideration be given to expanding the survey area to include the Regional Municipality of Niagara as one of the participating agencies. The Regional Municipality of Niagara conducted its own survey in 1987. A joint effort is likely to be the most efficient way to update the previous survey at the same time serving the data needs of the Regional Municipality of Hamilton-Wentworth given the strong travel ties between the two regions.

11.2.0 Survey Options

If the above recommendations are accepted, the 1996 survey will require approximately 90,000 household interviews to be completed. It is recommended that a survey of this size not be attempted from a single location with a single management team if it is to be done within a three and a half month period. Four alternative options are presented for consideration by the members of TATPDCSC and are as follows:

Option 1 - 3 Management Teams

The survey would be conducted from separate locations covering three geographic areas of approximately equal population. A separate management team would be established for each area consisting of a Chief Supervisor, a Coding Supervisor, a Computer Support Person and an Office Manager. The Survey General Manager would be required to provide the liaison between the three groups to ensure consistency.

Option 2 - Spread the Survey Over 3 Years

As in option one, the survey would be divided into three geographic areas, but they would be surveyed one at a time. The recommended sequence is:

Fall 1995 - Metropolitan Toronto

Fall 1996 - Durham, York and Peel

Fall 1997 - Halton, Hamilton-Wentworth and Niagara

Control totals from the 1996 Census could be used for expansion of the data in all three areas. The rationale for the above schedule is to survey the areas with the highest growth rates in the same year as the census. All of the data for Metro Toronto and the adjacent regions would be available for analysis by the summer of 1997.

Option 3 - Spread the Survey Over 1 1/2 Years With a Different Area Surveyed in Each of 3 Time Periods

This would be similar to Option 2 except one of the three areas would be surveyed in the January through April time period of 1997. The other two areas would be surveyed in the fall of 1996 and 1997. This option would be the most effective than Option 1 and Option 2 in terms of the utilization of staff resources and equipment.

Option 4 - Spread the Survey Over 1 1/2 Years With One Third of the Sample For Each Area Surveyed in Each of 3 Time Periods

The survey would be conducted over a 1 1/2 year time period as in Option 3, but 1/3 of the total sample required for every area would be done in each of the three time periods (e.g., September-December 1996, January-April 1997, September-December 1997). This option would provide the same efficiencies as Option 3 and would also yield trend information and seasonal variations for the 1996/1997 time period. The aggregate database for the three time periods would be used to represent 1996 conditions

11.3.0 Management Organization

It is recommended that a management organization be put into place which will see the 1996 survey through from initial design to analysis of the final database. The management organization should be in place for at least one year before the start of the survey.

11.4.0 Budget

Budget requirements for a 1996 survey are estimated as follows:

Development	$200,000
Survey (90,000 completed interviews @ $23/interview)	$2,070,000
Post Survey Analysis and Reports	$330,000
Total	**$2,600,000**

It is assumed that the amount of development work will be similar to the 1991 survey and that there will be some increase in the scope of the post survey analysis and reports. A 15% inflation factor (3% per year) has been included. Clearly, there could be considerable variation from the above estimates depending on the scope of the survey, the approach taken and the organization. The above estimate is recommended for preliminary discussion purposes.

APPENDIX I

1991 TRANSPORTATION TOMORROW SURVEY PROPOSAL

UNIVERSITY OF TORONTO / YORK UNIVERSITY
JOINT PROGRAM IN TRANSPORTATION

Data Management Group

December 6, 1989

1991 Survey Proposal

Background

At the September 21, 1989 meeting of the Toronto Area Transportation Planning Data Collection Steering Committee (TATPDCSC) a request was made to the Data Management Group (DMG) to prepare a proposal for the conduct of a travel survey in 1991. The request was made on the basis of the document "1991 Travel Survey" submitted to TATPDCSC by TRADMAG, a working sub group of TATPDCSC. That document contains a number of specific recommendations which have been used as a framework for this proposal. Those recommendations are:

- Survey area to consist of Metropolitan Toronto, the Regional Municipalities of Durham, York, Peel and Halton, and selected areas adjacent to the external boundaries of those Regions.
- Global sample of 0.5% of households.
- A 5% sample of households in high growth and fringe areas.
- A management structure be defined and staffing plan developed for the duration of the project (3 years).
- The survey be carried out from a location with convenient subway access.
- Interviewer wage rates be set slightly higher than current market research interviewer rates in order to attract good people.
- Training and supervision be provided by a transportation specialist.
- Previous telephone market research experience not be given a high priority.
- A single integrated data base be established on a minicomputer system containing both the initial sample information and survey data.
- On line data entry be used utilizing stand alone microcomputers and full screen editing software.
- The main data base be updated daily using software which also produces comprehensive performance and progress reports.
- The software be developed and tested in a pilot survey in the fall of 1990.

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Survey Organization

Exhibit 2.1 shows the survey organization that was used in TTS. For the 1991 survey it is proposed that the Data Management Group would undertake the following tasks internally:

- Financial administration
- Hardware evaluation and acquisition
- Software specification and development
- Pilot survey
- Terms of reference for sub contractors

The Data Management Group would also assume the responsibility for the management of the survey and coordination of all activities. A member of the DMG staff will be appointed as the General Manager of the survey from inception through to completion of the project. Products of the survey will include a clean data base, documentation of survey procedures, a data guide and a summary report or reports as determined by the Steering Committee. He will report directly to the Steering Committee. An assistant will be hired or appointed at the appropriate time. The DMG will hire or appoint a chief supervisor to hire and train interview staff for the pilot survey. If possible the same supervisor will be retained for the full survey.

The continuity provided through the Data Management Group is anticipated to reduce the work load placed on the members of the Steering Committee but their active involvement in the design and conduct of the survey is seen as being essential to its success. It is proposed that each member of TRADMAG be appointed to coordinate at least one of the following activities:

- Ongoing quality control
- Sample design and control
- Questionnaire design
- Publicity
- Interview procedures
- Coding procedures
- Validation, expansion and integration with TTS
- Report outline

Coordinators would coopt other members of TRADMAG as necessary to provide advice and assistance. The manager and/or his assistant will participate in all meetings in order to ensure overall coordination.

Pilot Survey

It is proposed that the pilot survey be carried out in the spring of 1991, not the fall of 1990 as originally proposed. Although the conduct of the TTS pilot survey in the spring of 1986 did not provide adequate time to assess the results and to make changes for the main survey in the fall, it is assumed that for 1991 all major decisions regarding survey content, method of interviewing, sample procedure and sample control, will have been made prior to the pilot survey. The objectives of the pilot will be to provide a final comprehensive test of all components of the software, procedures and interview text with the assumption that minor revisions only will be necessary. The individual components will have undergone extensive testing as part of the development process including the conduct of simulated interviews with relatives and/or other staff.

The pilot survey will be conducted out of the Data Management Group offices at 42 St. George Street. The Data Management Group will retain interview and coding supervisors. The interview supervisor will be responsible for hiring, training and supervising the interview staff. The coding supervisor will be responsible for ensuring that all coding procedures are operational and satisfactory. The availability of the same persons to be the chief supervisor and head of coding for the main survey would be a major factor in their selection.

It is envisaged that the pilot survey will consist of approximately 1000 interviews, will require 4 interviewers and will take 4 weeks to complete. Consideration will also be given to having each of the Regions carry out a number of interviews from their own offices in addition to the ones carried out at the Data Management Group.

Software Development

The development and testing of software for direct data entry and management of the survey will be critical items on the minimum time path for completion of the survey. Development work will need to start in January 1990 in order to ensure that all components are adequately tested in advance of the pilot survey. A critical decision point will be December 1990 by which time all aspects of the direct data entry software will need to be proven in order to proceed with the pilot. A second decision point on the use of the software will occur immediately after the pilot. It is estimated that a minimum 6 month lead time would be required to implement a paper survey should the direct data entry be considered too high a risk at that point.

The intention is to develop the software in modular form for application to future surveys as well. The first step in the development process will be to define a data base structure and the details of the various procedures which need to take place involving access to that data base.
Main components of the data base will be:

A. Survey Related

i) Household information
-original sample data
-status flags
-survey data

ii) Person information
-from survey

iii) Trip information
-from survey

B. Ancillary information used in coding
-Area Master File
-Monument file
-Transit routes
-Zone boundaries

Processes which involve access to the data base will include:

- Generation of base sample information
- Production of advance mailings to inform each household
- Generation of daily samples for each interviewer
- Update of data base with new interview data
- Production of status reports
- Geocoding
- Error reporting and correction
- AMF/Monument file updating

Many of the above processes will need to be carried out in parallel requiring simultaneous access to a central data base. The necessary inter-actions between modules will be specified in detail as part of the software specifications along with procedures for back up protection. The data base plan will also show how a paper survey could be incorporated into the procedures as a contingency plan.

Hardware Selection

Survey cost estimates assume that an existing computer system will be used to maintain the data base and manage the survey. An evaluation of alternative systems available will be performed in the initial phase of the survey project. Possible alternatives include:

1. The DMG minicomputer.
2. The MTO Convergent Technology system.
3. A combination of the two.
4. A new system.

The CT system owned by the MTO was used in the TTS. All of the geocoding software developed for the TTS and subsequent geocoding projects, including the 1986 census POW, is still resident on that system. An important part of the evaluation will be a comparison of the estimated cost of updating that software relative to moving it to a new system. Other factors to be considered will include the level of technical expertise available for support, availability of the system, convenience and future needs beyond the 1991 survey. The desired structure of the data base and associated processes may also influence the decision.

The use of an individual micro-computer for direct data entry by each interviewer will be used as a baseline for comparison of alternative configurations. The software will be similar to that use for the direct data entry portion of the 1986 Pilot survey and will have full screen editing capability. Floppy diskettes will be used to enter the daily sample and for transfer of the data back to the main computer system. Alternative arrangements using small clusters of work stations connected to a single processor will be evaluated for cost effectiveness, ease of monitoring and risk.

Survey Questionnaire

The questionnaire used in the 1986 TTS will be used as a base for review. An initial review will be carried out early in 1990 to determine whether there should be any significant change in content and whether the questionnaires for the 0.5% global sample and the 5% high growth sample should be identical. The global sample will be used for time series comparison with the 1986 survey and the high growth sample will have to be merged with the 1986 data in order to provide complete origin destination information updated to 1991. In both cases a high degree of consistency with the 1986 survey, in terms of both content and definition, is essential. Any change will therefore require substantial justification with the onus on the proponent to prove that the consistency and validity of the time series data will not be placed in jeopardy.

A more detailed review of the exact wording of the questions and the interviewers script will be carried out prior to the pilot and again before the main survey.

Sample Design

The sample design depends on the uses to which the data is to be put and the method used to expand the data to represent the universe of travel patterns in the Greater Toronto Area. The basic sampling unit is the household and it is proposed that the same method of expansion be used as in TTS. That is the application of an expansion factor which is the inverse of the proportion of total households sampled within a defined geographic area. It is recommended that a minimum aggregation of 100 households sampled be used for calculation of each expansion factor to ensure statistical validity. It follows that the minimum number of households in a geographic area to be sampled at a different rate from adjacent areas will be 100 times the sampling rate (2000 at 5% or 20,000 at 0.5%).

The sample design and procedures will be reviewed as one of the first steps in the survey design. It is recommended that use of the same expansion zones as in TTS be evaluated as one option for definition of high and low growth area. These areas were defined for the purpose of applying expansion factors and their continued use would simplify the procedure for combining the 1986 and 1991 survey results.

For time series comparison with the 1986 data it is anticipated that the 1991 survey results, high and low sample rates combined, will be expanded to represent the total population. In order to define a new origin - destination data base it is envisaged that only the high sample rate data would be used, combined with the 1986 data for other areas. The expansion factors used in 1986 would be recalculated to reflect changes in population.

It is proposed that the sample be obtained from Bell Canada residential phone listings in the same manner as for TTS. The procedure will be to select every nth listing in each geographic area sorted by street address. Each address will be assigned a random number to determine the sequence of use.

Sample Rates

Although the sampling technique and sample control procedures must be defined in order for software development to proceed, the final decisions on the geographic boundaries and sampling

rate in each area need not be finalized before June 1991. An accurate estimate of the total sample size will be required in order to finalize the budget for 1991 but does not affect the 1990 budget.

1990 Budget

Hardware evaluation	$5,000	
Software development	75,000	
Instrument design & manuals	17,000	
Sample	5,000	
Management	65,000	
Computer hardware	10,000	
Contingency	8,000	
Total	$185,000	(University overhead included)

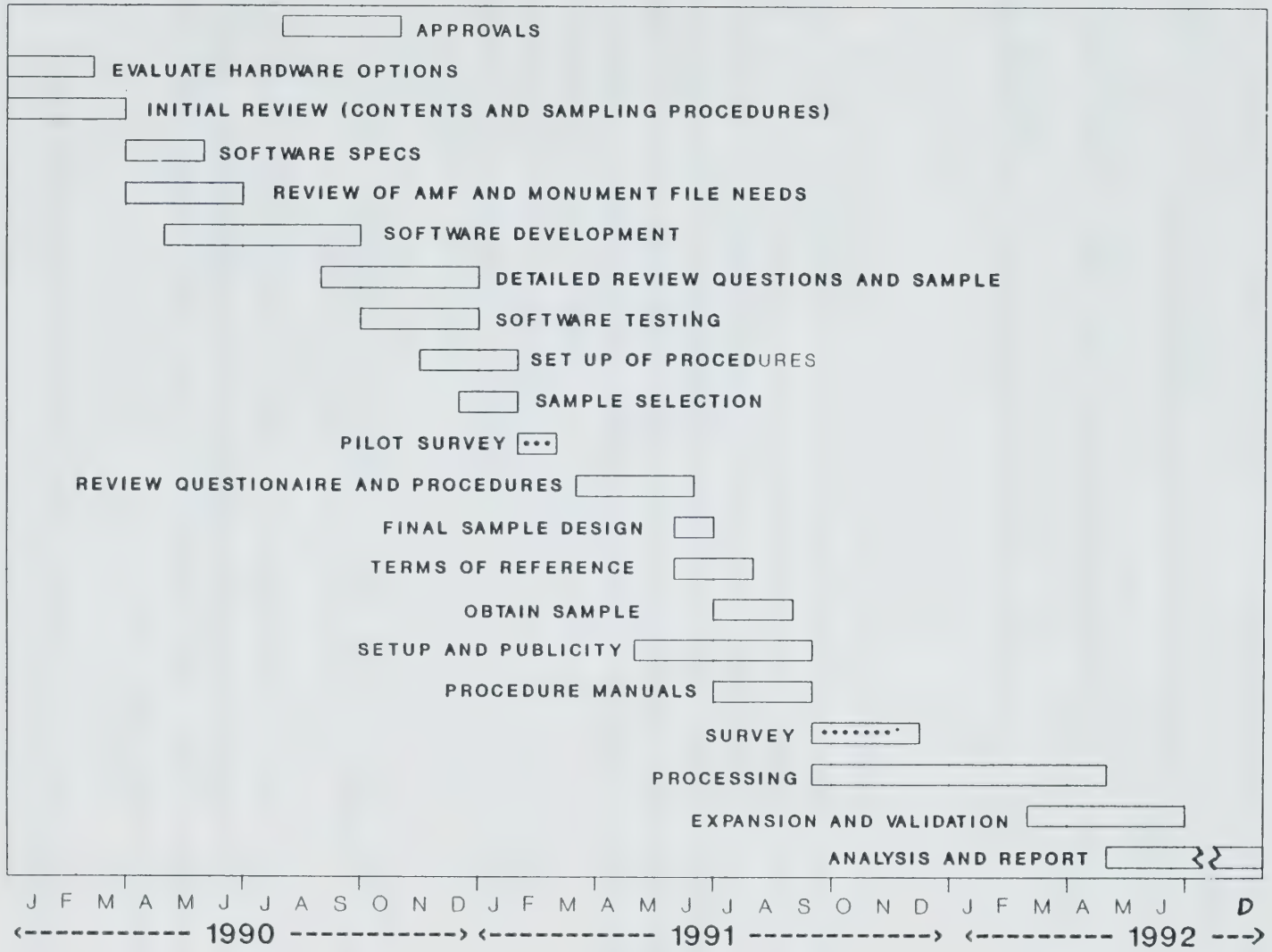
Cost Sharing

The following table shows the projected cost to each Regional Municipality for each of the 3 years. The costs have been revised from those previously presented in the document "1991 Travel Survey", to reflect the deferral of the pilot survey from the fall of 1990 to the spring of 1991. It is assumed that the costs will be shared in proportion to total population and that MTO will provide a 75% subsidy. The cost estimate for 1991 is based on a total sample of 20,000 households.

Any increase or decrease in the total sample would change the 1991 estimated cost by $15/household. One of the first tasks in preparation for the survey is a review of sampling procedures and rates. If there are any changes recommended they should be available by September 1990 for incorporation into revised budget estimates for 1991.

	1991 Assumed Pop. (%)	1990 $	1991 $	1992 $
MTO	N/A	$138,800	$281,200	$180,000
Metro/TTC	55	25,400	51,600	33,000
Durham	10	4,600	9,400	6,000
York	11	5,100	10,300	6,600
Peel	17	7,900	15,900	10,200
Halton	7	3,200	6,600	4,200
	100	185,000	375,000	240,000

SCHEDULE


APPROVALS
EVALUATE HARDWARE OPTIONS
INITIAL REVIEW (CONTENTS AND SAMPLING PROCEDURES)
SOFTWARE SPECS
REVIEW OF AMF AND MONUMENT FILE NEEDS
SOFTWARE DEVELOPMENT
DETAILED REVIEW QUESTIONS AND SAMPLE
SOFTWARE TESTING
SET UP OF PROCEDURES
SAMPLE SELECTION
PILOT SURVEY
REVIEW QUESTIONAIRE AND PROCEDURES
FINAL SAMPLE DESIGN
TERMS OF REFERENCE
OBTAIN SAMPLE
SETUP AND PUBLICITY
PROCEDURE MANUALS
SURVEY
PROCESSING
EXPANSION AND VALIDATION
ANALYSIS AND REPORT
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J D
1990
1991
1992

15 June 1989

1991 Travel Survey

1. Objectives

a) Obtain time series data on global trends in travel behaviour (trip rates, modal split, trip lengths, etc..)

b) To update the TTS data base in geographic areas where significant change has taken place.

c) To refine survey procedures based on the experience gained in the TTS before that experience is lost.

2. Sample Size

Accuracy and statistical confidence intervals depend on the total number of observations in each category, not on percent of total population. Dependent on circumstances between 50 and 150 observations of a single variable or cell are needed to provide reliable estimates. A sample of 1000 is often used for political opinion polls. 2000 observations provides for extensive cross classification of respondents. Most recent travel surveys in the U.S. have used samples in the 2000 to 4000 household range for analysis of travel behaviour and calibration of model parameters.

A half percent sample in the GTA would yield approximately 8000 household interviews, sufficient for extensive cross classification including stratification by regional municipality.

For analysis of data at the traffic zone level and by specific origin/destination pairs much larger samples are required, generally the maximum that can be afforded.

A 5% sample would provide a reasonably accurate estimate of any sub population of 2000 or greater. The sub population could refer to trips to or from a single traffic zone, aggregate zone to zone movements, traffic using a specific road or transit link or the total transit ridership in a municipality or on a specific route.

The recommended sample is therefore 0.5% globally and 5% in high growth areas.

3. Problem Areas in TTS

a) *Lack of Continuity*

The pilot project was carried out by one contractor under the direction of the Steering Committee. A second contractor conducted the main survey. A project manager was hired for 9 months to oversee the selection of the contractor and the conduct of the main survey but time ran out before the processing of the survey was complete. Much of that processing and subsequent analysis was done first at the Ministry and subsequently by the Data Management Group. These changes were costly in both time and money. In addition the lead time between the pilot and the main survey was insufficient to use the experience gained in the pilot to refine the main survey.

Recommendation

- A management structure be defined and staffing plan developed for the duration of the project (3 years).

b) *Interviewer selection/training/supervision*

A continuous problem in TTS was the availability of a sufficient number of interviewers (120) with the approprate aptitude. Poor transit access to the contractors premises appeared to be a limiting factor in the availability of interviewers. In addition the market research industry as a whole did not exhibit a good understanding of transportation data requirements.

Recommendations

- the survey be carried out from a location with convenient subway access
- interviewer wage rates be set slightly higher than current market research interviewer rates in order to attract good people,
- training and supervision be provided by transportation specialist, and
- previous telephone market research experience be given a low priority

c) *Sample Control*

Problems in TTS resulted from

- o no electronic transfer of data from initial sample to the final data base (address information etc, had to be re-rentered)
- o delay in data entry, transfer and checking, and
- o the computer system was unable to handle the complete data base at one time.

The result of these problems led to ineffective monitoring of interviewer performance, the inability to make timely call backs to check information, the need for additional interviews 3 months later to correct for sample bias, increased scope for error and greatly increased elapsed time to process the data. All these factors tended to increase the total cost incurred.

Recommendations

- o a single integrated data base be established on a mini computer system containing both the initial sample information and the survey data
- o on line data entry be used utilizing stand alone micro computers and full screen editing software
- o the main data base be updated daily using software which also produces comprehensive performance and progress reports
- o the software be developed and tested in a pilot survey in the fall of 1990, or spring of 1991.

4. Cost Estimates

The total cost of TTS was considerably in excess of the $825,000 in direct costs incurred for the survey itself. Estimated costs not included are:

Pilot Survey	($37,000)
Software development by MTO	($50,000)
Trip diary	($51,000)
MTO and Region staff costs	($200,000)
Analysis/Report production by DMG	($150,000)

A realistic estimate of the total cost is in the $1.2M to $1.5M range.

Estimated costs for a 1991 survey are as follows:

	Recommended Sample (20,000 households)	4.5% Global Sample (70,000 households)
Survey Management*	$270,000	$270,000
Software Development	80,000	80,000
Pilot Survey	50,000	50,000
Conduct of Survey (Interviewing, data entry, checking @ $15/household)	300,000	1,050,000
Analysis and Summary Report	100,000	100,000
	$800,000	$1,550,000

*Survey director full time for 1 year, and half time for 2 years plus an assistant for 18 months.

Break down by year

Year	Recommended Sample	4.5% Global Sample
1990	$200,000	$200,000
1991	370,000	880,000
1992	230,000	470,000
	$800,000	$1,550,000

5. Cost Sharing Options

a) On the basis of population (same as TTS)

b) On the basis of sample

c) Combination

- o front end and report costs (1990 and 1992) on basis of population
- o survey costs (1991) on basis of sample

The latter opinion offers the advantage that all agencies share in the fixed costs associated with a global small sample at the same time as providing maximum flexibility for individual agencies to increase the sample in particular areas to meet their individual needs.

6. Recommendation for Immediate Action

TRADMAG develop a set of recommendations for presentation to the Steering Committee in September. Items to be covered: -

a) need for survey
b) funding
c) management structure
d) role of Data Management Group

possibilities for the latter include:

- o preparation of terms of reference
- o software development
- o contract management
- o financial administrator

Peter M. Dalton

APPENDIX II

CHIEF SUPERVISOR'S REPORT

THE

TRANSPORTATION TOMORROW SURVEY
1991

DRAFT
CHIEF SUPERVISOR'S REPORT

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PREFACE

"IT'S OUT OF CONTROL, LET'S STOP, CALL THIS THE PILOT, REGROUP AND START AGAIN IN A WEEK."

Thanks to superior preplanning and the opportunity to participate in the initial phases, the 1991 TRANSPORTATION TOMORROW SURVEY was the first large scale data collection project I have supervised when I haven't wanted to call a halt to everything at the end of the first week and start all over again.

I have tried to address most of the reasons for the above in the Acknowledgement section and body of this report.

Unlike the 1986 TTS, I had the opportunity to contribute to the 1991 TTS General Report and therefore will try to avoid duplication here.

ACKNOWLEDGEMENTS

I would like to thank the following people and agencies for their help and foresight:

The TORONTO AREA TRANSPORTATION DATA COLLECTION STEERING COMMITTEE for drawing upon the learning experiences of the 1986 TTS and for their excellent choice of Management team;

The various SUBCOMMITTEES and their members from the Regional Municipalities, Metro Toronto and the TTC;

PETER DALTON and JERRY NG for doing whatever was necessary whenever it was necessary in order to achieve our goals and for their superb Management organization;

The DATA MANAGEMENT GROUP especially Janet, Jen and Sue for their help with often unrecognized tasks, making our jobs much easier, and the rest of the staff for putting up with us during the Pilot;

BA CONSULTING, although taking it to the wire at times, for pulling through when it counted;

The UNIVERSITY OF TORONTO and the DEPARTMENT OF CIVIL ENGINEERING, especially Gord for his help setting up the room;

The SUPERVISORS/TRAINERS for their efforts and subsequent feedback;

KATRIEN MABALAY for her initiative and healthy work ethic;

The GEOCODERS for their understanding of how difficult data collection can be and their logical common sense;

The INTERVIEWERS without whom .....!!;

ALL OF THE ABOVE again for working together as a team and contributing to an overall high level of morale.

OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

1. SELECTION OF CHIEF SUPERVISOR

The timing of the selection of Chief Supervisor was a great improvement over the 1986 TTS allowing for input in the earlier stages of the project. However, it is recommended that a Chief Supervisor with direct relevant experience be brought on line even earlier for the next survey to allow for input during all rewrites of the DDE and SCS software and to allow participation in all pretests.

2. PRETESTS/PILOTS

The experience gained during the 1991 TTS has proved that conducting numerous smaller pretests is an effective method of testing the DDE software and the interview in general. The larger Pilot survey should be timed to allow for fine tuning different aspects of the survey and retention of staff.

3. PUBLICITY

In 1991 a radio announcer received phone calls regarding the legitimacy of the survey. Being a Saturday, this announcer was unable to obtain confirmation of the legitimacy of the survey from either the Ministry or the Police and stated such on the air.

(A similar scenario could have occurred any weekday after 4:30PM.)

Although clarification was aired, the damage had already been done and showed up in slightly increased refusal rates.

The value of time, effort and money expended on public awareness of the TTS is very hard to measure. The effect of bad publicity is not. Perhaps in future, letters to radio and television stations should relate the experience of 1991 and request that memos go to the anouncer level within the station and to all desk sergeants within the various police departments.

A 24 hour contact number may prove to be beneficial as well.

4. ADVANCE LETTER

The value of the Advance Letter cannot be stressed enough and through its ever improving metamorphosis has directly affected response rates in a positive manner. Note: In the interest of cost, not one French translation was requested in 1986 or 1991.

5. SOFTWARE

The DDE and SCS software, while not perfect, proved to be, not surprisingly, very effective and efficient. The best productivity rate achieved by an individual interviewer in 1991 was approximately one completion per hour more than in 1986.

The elimination of handwriting and reduction of spelling errors has no doubt improved the overall quality of data and data processing time.

Although adding the typing skill requirement of interviewers, no prohibitive difficulty was encountered locating people with the minimum aptitude. It was found that a minimum typing speed of 30 to 40 wpm was required to conduct the interview without undue delay. Of course more speedy typists were able to achieve higher productivity rates.

6. QUALITY CONTROL/MONITORING

As discussed in this section in the General Report the methods employed to ensure the accuracy and quality of information collected and recorded proved successful. Special note should be made as to the usefulness of the audio–visual monitoring system as a training tool. It would also be optimum for all interview stations in future surveys to be equipped with this option regardless of handset/headset choice.

It was found that an interviewer could reduce his/her refusal rate by recording them as call–backs, no answers etc. This could be detected in the nightly reports but would have to be prolonged and significant. It is very important to train interviewers on how to minimize refusals while at the same time recognizing, accepting and recording legitimate refusals.

Although most interviewers perferred to use the same diskette night after night it was discovered that a systematic rotation caused some interviewers to find deficiencies in other interviewers' methods of recording comments and misrecording status. Therefore it would be beneficial to continue this rotation as an additional form of monitoring.

<u>The SCS software must be modified to be able to track the complete call record by the full name of the interviewer.</u>

Software adjustments should be made in order to speed up the processing and printing of daily completed interviews as the 100% visual check is an essential task that must be performed and organized before commencement of interviewing the following day. Feedback to interviewers contributed greatly to improving performance.

7. HIRING AND TRAINING OF INTERVIEWERS AND SUPERVISORS

Every effort should be made to retain the interviewers conducting the Pilot phase of the survey as Trainers for the main survey. It is then possible to recruit supervisors from this group but caution should be exercised as not everyone can be effective in this role.

It must be noted that the training program should be flexible enough to accommodate the varied speeds at which people learn. In 1991 some trainees were ready for "Live Training sample" as early as the end of "Night One" while others were still not ready by the mandatory 8:00 PM "Night Three" go live rule. In some of these cases, however, interviewers volunteered for additional practice and turned out to be adequate.

In general, the majority of trainees found three nights of training were adequate preparation. Therefore it is suggested that the training program as set out in the general report continue to be used in future surveys.

The full training of an interviewer includes at least one week of audio–visually monitored live interviewing following the initial three day training session. It is preferable that this week of interviewing be as immediate as possible. In most cases this is attainable. However, the interviewers trained in first three groups experience an 8 to 13 day lay–off. In 1991 it was necessary to call these people in for a refresher night of live training in the week prior to the start of the survey. This 8 to 13 day hiatus is potentially dangerous as it allows not only for forgetfulness but for the loss of interviewers to other employment. As with the interviewers employed for the conduct of the Pilot survey, these investments must be protected.

It is therefore suggested that enough Pilot survey sample be drawn to accommodate the continuation of live interviewing throughout the two weeks prior to the actual start date.

This would also reduce the learning curve, which would be essential, if embarking upon an even larger survey.

8. The 1996 TRANSPORTATION TOMORROW SURVEY

A major contributing factor to the relative success of the 1991 TTS was probably its managable size. If it is the Committee's intention to go ahead with the 1996 TTS with a sampling rate of 5–6% resulting in approx. 90,000 interviews, it is essential to carefully consider the managability of a project of that magnitude. Notwithstanding an efficient Management team, software, networking, processing time, advanced letter etc., ENOUGH properly trained and motivated interviewers and supervisors, with the right attitude, is by far the single most important factor for success.